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THIS CATALOGUE CONTAINS

USEFUL INFORMATION AND TABLES RELATIVE TO

STEEL, IRON AND OTHER PRODUCTS FOR BUILDINGS AND BRIDGES

PREPARED BY

MILLIKEN BROTHERS,

NEW YORK CITY, U. S. A.

ARRANGED FOR THE USE OF

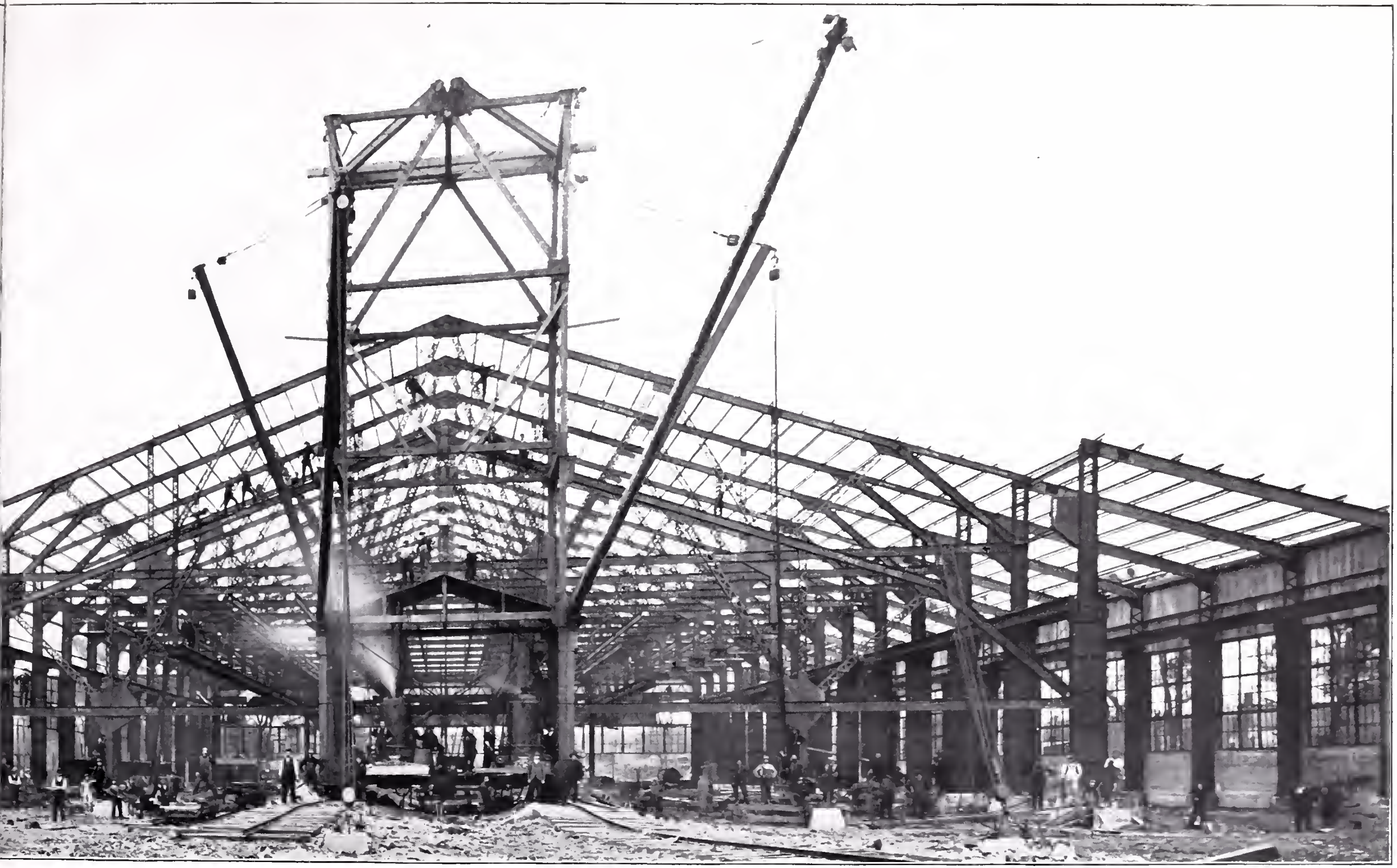
ENGINEERS, ARCHITECTS AND BUILDERS.

SECOND EXPORT EDITION, 1905.

NOTE:—THIS CATALOGUE IS ALSO PUBLISHED IN SPANISH, GERMAN AND FRENCH.

TEMPLET SHOP.

VIEW SHOWING PARTIALLY COMPLETED NEW PLANT OF MILLIKEN BROS., STATEN ISLAN



PUNCH AND LAYOUT SHOP.

N. Y. All Steel Work Designed, Furnished and Erected by Milliken Bros.

IMPORTANT NOTICE.

In ordering material from this book through any importing or commission house, it is necessary for you to advise them that the work is to come from Milliken Brothers; and refer particularly to the edition of this book, as the sections shown are liable to be changed, and sections made by other parties vary from sections as shown in this book.

All sections of rolled steel and iron are sold by weight and not by measurement, therefore the sections are liable to vary slightly from the sections as shown in this work.

We are often asked to send out general price lists. In this class of material, where the goods are specially designed for some particular work and the character of the work varies so largely, we find it impossible to make any general price list except for raw material, which is not manufactured. We therefore prefer to quote on each inquiry as received. The prices are subject to change from time to time according to the ruling market rates for raw material; and all quotations are subject to change without notice unless specifically stated in the estimate. All deliveries are contingent on strikes, delays and accidents beyond our control.

PREFACE.

The object of this catalogue is to give to foreign countries, as far as possible, a general idea of what we are able to furnish in the way of iron, steel and other products for buildings, bridges, etc. So far as we know no other parties have ever undertaken to get up such a catalogue, and we trust that this work will meet with general favor

As you are no doubt aware, the standard of measure in the United States is the English, namely: the inch, foot and yard; and the standard weights are pounds and tons. In nearly all foreign countries the standard of measure and weights is on the French metric system; in this catalogue we have used both forms so that parties can instantly see the two forms of measures and weights. We have also published complete tables so that the equivalents of all measures and weights can be instantly transferred from one system to the other.

It is now a well known fact that the United States of America leads all other countries in the production of iron and steel. It has been evident to our firm for some years back that it was necessary to find an outlet in foreign countries for our manufactured product. For many years back, England, Germany and France have held and controlled the trade of foreign countries in this product. Prices of iron and steel in the United States are much lower than in the above mentioned foreign countries, and in a number of instances we have

been able to successfully compete for delivery of our goods in these countries direct, therefore we feel that by properly presenting the class of goods which we manufacture to foreign countries—that have no idea of the great variety of work that we turn out—we may be able to still further increase our foreign trade, which in the last few years has increased very rapidly. Nearly all foreign countries prefer this class of work to come from the United States for a number of reasons.

In the first place we are able to execute orders much more quickly than our foreign competitors; in other words, we turn out the structural steel work for finished buildings in five or six weeks from date of order, while it takes our competitors as many months to execute a similar order, owing to the effective system that we have for getting out our work.

Our work is all made by template; that is, the piece is first executed in wood and then all similar pieces are made from the same wooden template. This insures accuracy and prevents trouble when work comes to be erected at its destination. This may seem to be a small and unimportant matter to those who have not had experience, but the amount of time wasted and the expense of having to alter work in a foreign country, where facilities are very often limited, is a matter of no small moment.

Our system of marking and shipping the work we believe is also better than that of our foreign competitors. This makes it an easy matter to pick out the pieces and properly assemble the structure after it is received. We feel therefore, that even at even figures, the preference should be given to the manufacturer in the United States.

The tables of sizes, weights, etc., will be found very useful in ordering raw material, and also to engineers in designing their work.

The use of rolled iron for structural purposes has been entirely superseded in this country by the use of rolled steel, which is cheaper to make and for a given strength is much lighter. Parties will please understand therefore that all quotations and estimates are based on the use of steel unless otherwise specially specified.

We can ship from stock almost all of the classes of raw material called for in this catalogue.

Our principal business is the manufacture of all classes of iron, steel and other products that enter into buildings and bridges, but as will be noted we make a specialty of erecting buildings complete.

It is almost impossible in this small work to go into the thousand-and-one articles that enter into the construction of, for instance, one of our tall office buildings, and considering all of the other classes of work which we manufacture, if parties do not find in this work any special form of construction or class of material, please remember we can probably make the same and that if you clearly state what is desired we shall be pleased to make sketches, specifications and estimates on receipt of full information.

We have in our main office alone a force of about one hundred and fifty engineers and draftsmen who are employed to make these drawings and specifications; and we hope that, if you contemplate ordering any work in our line, you will allow us the privilege of making you a quotation on same.

SHAPES

MANUFACTURED BY

MILLIKEN BROTHERS,

11 BROADWAY,

NEW YORK CITY, U. S. A.

Plate No. 1.

Steel Bars standard sizes.

Round

3/8"	7/16"	1/2"	9/16"	5/8"	11/16"	3/4"	13/16"	7/8"	15/16"	1"	1 1/16"	1 1/8"	1 3/16"
9·52,	11·11,	12·69,	14·28,	15·87,	17·46,	19·04,	20·63,	22·22,	23·80,	25·39,	26·98,	28·56,	30·15,
1 1/4"	1 5/16"	1 3/8"	1 7/16"	1 1/2"	1 5/8"	1 3/4"	1 7/8"	2"	2 1/8"	2 1/4"			
31·74,	33·32,	34·91,	36·50,	38·09,	41·27,	44·44,	47·62,	50·79,	53·97,	57·14,			
2 3/8"	2 1/2"	2 5/8"	2 3/4"	2 7/8"	3"	3 1/8"	3 1/4"	3 3/8"	3 1/2"				
60·32,	63·49,	66·67,	69·84,	73·02,	76·19,	79·37,	82·54,	85·72,	88·89,				
3 5/8"	3 3/4"	3 7/8"	4"	4 1/8"	4 1/4"	4 3/8"	4 1/2"						
92·07,	95·24,	98·42,	101·59,	104·77,	107·94,	111·12,	114·29,						
4 5/8"	4 3/4"	4 7/8"	5"	5 1/4"	5 1/2"								
117·47,	120·64,	123·82,	126·99,	133·34,	139·69,								
5 3/4"	6"	6 1/4"	6 1/2"	6 3/4"									
146·04,	152·39,	158·74,	165·09,	171·44.									

Square

3/8"	7/16"	1/2"	9/16"	5/8"	11/16"	3/4"	13/16"	7/8"	15/16"	1"	1 1/16"	1 1/8"
9·52,	11·11,	12·69,	14·28,	15·87,	17·46,	19·04,	20·63,	22·22,	23·80,	25·39,	26·98,	28·56,
1 3/16"	1 1/4"	1 3/8"	1 1/2"	1 3/4"	2"	2 1/8"	2 1/4"	2 3/8"	2 1/2"			
30·15,	31·74,	34·91,	38·09,	44·44,	50·79,	53·97,	57·14,	60·32,	63·49,			
2 5/8"	2 3/4"	2 7/8"	3"	3 1/4"	3 1/2"	3 3/4"	4"					
66·67,	69·84,	73·02,	76·19,	82·54,	88·89,	95·24,	101·59,					
4 1/4"	4 1/2"	4 3/4"	5"									
107·94,	114·29,	120·64,	126·99.									

Halfround

3/8"	7/16"	1/2"	9/16"	5/8"	11/16"	3/4"	13/16"	7/8"
9·52,	11·11,	12·69,	14·28,	15·87,	17·46,	19·04,	20·63,	22·22,
15/16"	1"	1 1/8"	1 1/4"	1 3/8"	1 1/2"			
23·80,	25·39,	28·56,	31·74,	34·91,	38·09,			
1 5/8"	1 3/4"	2"	2 1/4"	2 1/2"				
41·27,	44·44,	50·79,	57·14,	63·49,				
3"	3 1/2"	4"						
76·19,	88·89,	101·59.						

All dimensions are given in millimetres and inches

Steel Bars standard sizes.

Flats.

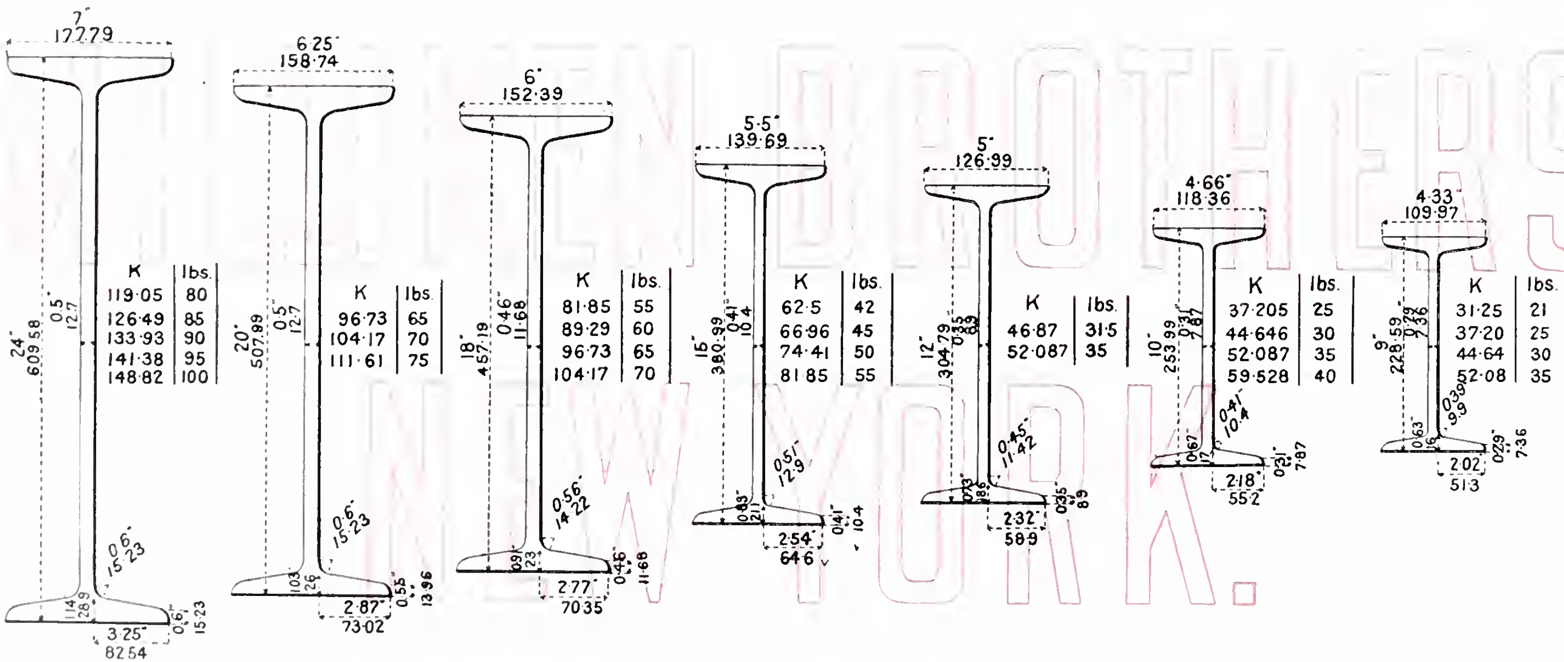
Millimetres and inches	Width.	Thickness.	Width.	Thickness.	Width.	Thickness.	Width.	Thickness.	Width.	Thickness.	Width.	Thickness.
	5/8" 15·87	1/8" 1/2" 3·14 to 12·69	1 1/8" 28·56	1/8" 1" 3·14 to 25·39	1 3/4" 44·44	1/8" 1 5/8" 3·14 to 41·27	2 3/4" 69·84	1/4" 2 1/2" 6·34 to 63·49	3 3/4" 95·24	1/4" 2" 6·34 to 50·79	5" 126·99	1/4" 2" 6·34 to 50·79
	3/4" 19·04	1/8" 5/8" 3·14 to 15·87	1 1/4" 31·74	1/8" 1" 3·14 to 25·39	2" 50·79	3/16" 1 3/4" 4·76 to 44·44	3" 76·19	1/4" 2 3/4" 6·34 to 69·84	4" 101·59	1/4" 2" 6·34 to 50·79	5 1/4" 133·34	1/4" 2" 6·34 to 50·79
	7/8" 22·22	1/8" 3/4" 3·14 to 19·04	1 1/2" 38·09	1/8" 1 1/4" 3·14 to 31·74	2 1/4" 57·14	1/4" 1 3/4" 6·34 to 44·44	3 1/4" 82·54	1/4" 1 5/8" 6·34 to 41·27	4 1/4" 107·94	1/4" 2" 6·34 to 50·79	5 1/2" 139·69	1/4" 2" 6·34 to 50·79
	1" 25·39	1/8" 15/16" 3·14 to 23·81	1 5/8" 41·27	1/4" 1 1/2" 6·34 to 38·09	2 1/2" 63·49	1/4" 2 1/4" 6·34 to 57·14	3 1/2" 88·89	1/4" 2" 6·34 to 50·79	4 1/2" 114·29	1/4" 2" 6·34 to 50·79	5 3/4" 146·04	1/4" 2" 6·34 to 50·79

List of extreme sizes of rectangular plates.

Thickness in mm and in's	Width of plate in millimetres and inches.											
	84" 2133·5	78" 1981·1	72" 1828·7	66" 1676·3	60" 1523·9	55" 1396·9	50" 1269·9	45" 1142·9	40" 1015·9	35" 888·9	30" 761·9	24" 609·5
	Length in M and inches	Length in M and inches	Length in M and inches	Length in M and inches	Length in M and inches	Length in M and inches	Length in M and inches	Length in M and inches	Length in M and inches	Length in M and inches	Length in M and inches	Length in M and inches
1" 25·4	96" 2·43836	108" 2·74315	114" 2·89554	120" 3·04794	126" 3·20033	136" 3·45433	144" 3·65753	168" 4·26712	180" 4·57192	192" 4·87671	216" 5·48630	240" 6·09589
3/4" 19·04	120" 3·04794	132" 3·35274	144" 3·65753	144" 3·65753	156" 3·96233	174" 4·41951	190" 4·82591	204" 5·18151	216" 5·48630	228" 5·79110	240" 6·09589	240" 6·09589
5/8" 15·87	132" 3·35274	144" 3·65753	156" 3·96233	168" 4·26712	180" 4·57192	192" 4·87671	204" 5·18151	216" 5·48630	228" 5·79110	228" 5·79110	240" 6·09589	240" 6·09589
9/16" 14·28	150" 3·80992	156" 3·96233	168" 4·26712	180" 4·57192	192" 4·87671	204" 5·18151	216" 5·48630	228" 5·79110	228" 5·79110	240" 6·0958	240" 6·09589	240" 6·09589
1/2" 12·69	192" 4·87671	216" 5·48630	228" 5·79110	228" 5·79110	240" 6·09589	240" 6·09589	240" 6·09589	240" 6·09589	268" 6·80707	288" 7·31507	300" 7·61986	300" 7·61986
7/16" 11·11	228" 5·79110	228" 5·79110	228" 5·79110	240" 6·09589	240" 6·09589	240" 6·09589	240" 6·09589	256" 6·50227	288" 7·31507	300" 7·61986	300" 7·61986	300" 7·61986
3/8" 9·52	228" 5·79110	236" 5·99429	240" 6·09589	250" 6·34988	260" 6·60387	260" 6·60387	274" 6·95947	288" 7·31507	300" 7·61986	300" 7·61986	300" 7·61986	300" 7·61986
5/16" 7·93	204" 5·18151	240" 6·09589	250" 6·34988	260" 6·60387	276" 7·01027	274" 6·95947	288" 7·31507	288" 7·31507	300" 7·61986	300" 7·61986	300" 7·61986	300" 7·61986
1/4" 6·34	192" 4·87671	192" 4·87671	204" 5·18151	204" 5·18151	204" 5·18151	216" 5·48630	288" 7·31507	288" 7·31507	300" 7·61986	300" 7·61986	300" 7·61986	300" 7·61986

Plate No. 3.

Steel Beams, standard sections.



24" beam:

K	lbs.
119·05	80
126·49	85
133·93	90
141·38	95
148·82	100

20" beam:

K	lbs.
96·73	65
104·17	70
111·61	75

18" beam:

K	lbs.
81·85	55
89·29	60
96·73	65
104·17	70

15" beam:

K	lbs.
62·5	42
66·96	45
74·41	50
81·85	55

12" beam:

K	lbs.
46·87	31·5
52·087	35

10" beam:

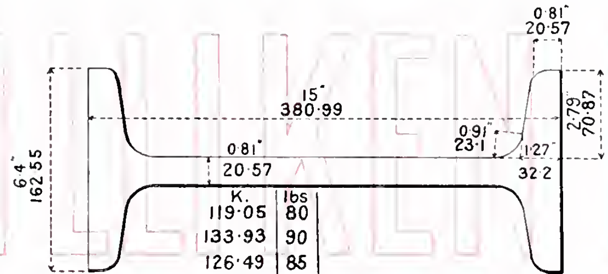
K	lbs.
37·205	25
44·646	30
52·087	35
59·528	40

9" beam:

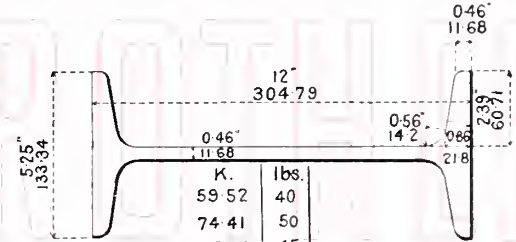
K	lbs.
31·25	21
37·20	25
44·64	30
52·08	35

All dimensions are given in millimetres, and inches.
All weights are given in kilogramsper metre, and pounds per lineal foot.
All dimensions given are for minimum weight of each section.

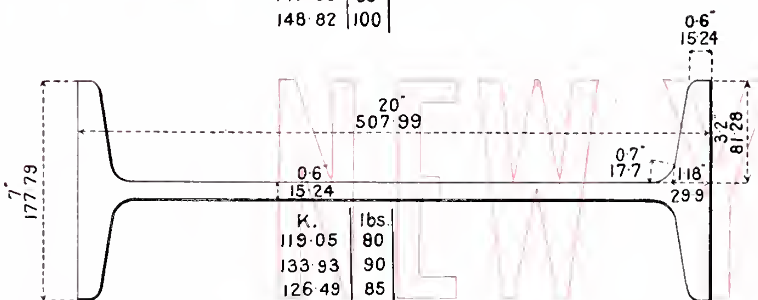
Steel Beams, standard sections.



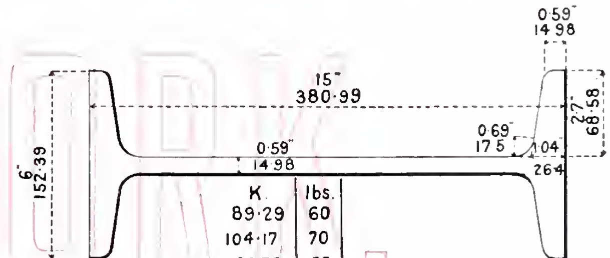
K.	lbs
119·05	80
133·93	90
126·49	85
141·38	95
148·82	100



K.	lbs.
59·52	40
74·41	50
66·95	45
81·85	55



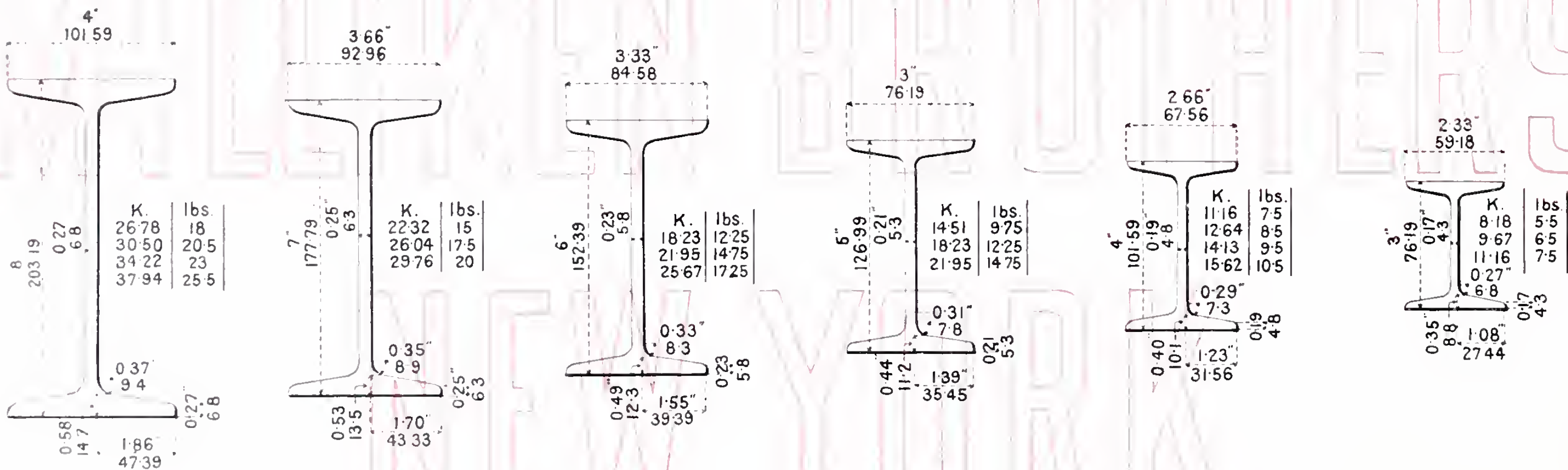
K.	lbs.
119·05	80
133·93	90
126·49	85
141·38	95
148·82	100



K.	lbs.
89·29	60
104·17	70
96·73	65
111·61	75

All dimensions are given in millimetres, and inches.
All weights are given in kilograms per metre, and pounds per lineal foot.
All dimensions given are for minimum weight of each section.

Steel Beams, standard sections.



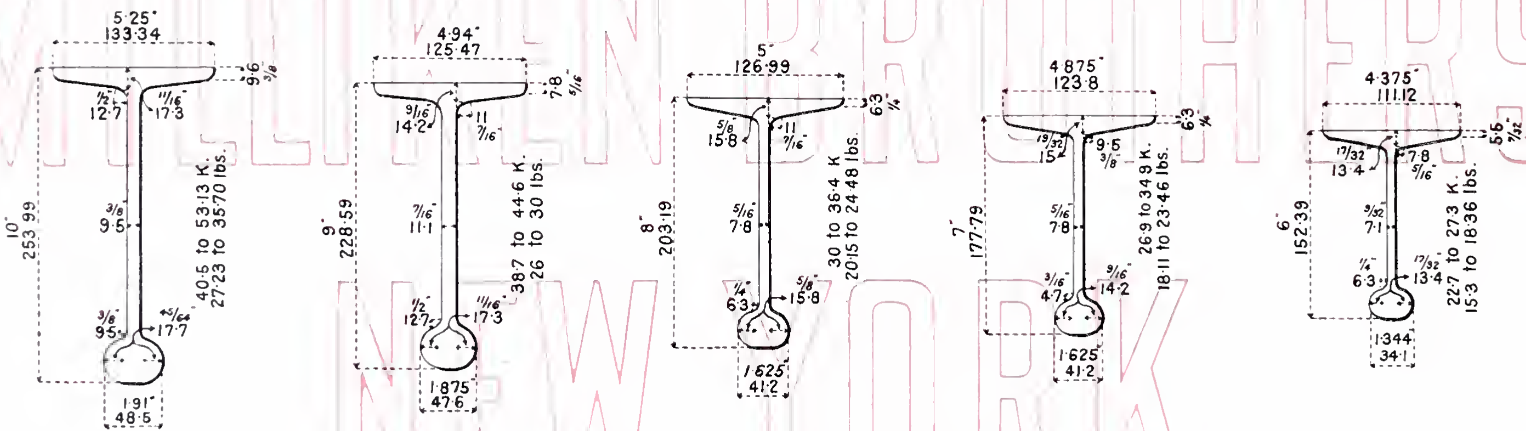
All dimensions are given in millimetres and inches
All weights are given in kilograms per metre and pounds per lineal foot
All dimensions given are for minimum weight of each section

Plate No. 6.

Maximum, intermediate and minimum weights and dimensions of steel Beams, standard sections.

Depth of beam m.m	Depth of beam inches.	Weight per M. Kilogramme.	Weight per ft. lbs.	Width of flange m.m.	Width of flange inches	Thickness of web m.m.	Thickness of web inches	Depth of beam m.m	Depth of beam inches	Weight per M. Kilogramme.	Weight per ft. lbs.	Width of flange m.m.	Width of flange inches	Thickness of web m.m.	Thickness of web inches
609·58	24	148·82	100	184·14	7.254	19·1	0·754	304·79	12	81·85	55	142·54	5·612	20·8	0·822
		141·38	95	182·62	7·192	17·5	0·692			74·41	50	139·40	5·489	17·7	0·699
		133·93	90	181·09	7·131	16·0	0·631			66·96	45	136·29	5·366	14·6	0·576
		126·49	85	179·57	7·070	14·4	0·570			59·52	40	133·34	5·250	11·6	0·460
		119·05	80	177·79	7·000	12·7	0·500	253·99	10	59·52	40	129·53	5·099	19·0	0·749
507·99	20	148·82	100	185·00	7·284	22·4	0·884			52·08	35	125·77	4·952	15·2	0·602
		141·38	95	183·13	7·210	20·5	0·810			44·64	30	122·03	4·805	11·5	0·455
		133·93	90	181·26	7·137	18·7	0·737			37·20	25	118·36	4·660	7·8	0·310
		126·49	85	179·39	7·063	16·8	0·663	228·59	9	52·08	35	121·20	4·772	18·6	0·732
		119·05	80	177·79	7·000	15·2	0·600			44·64	30	117·05	4·609	14·4	0·569
		111·61	75	162·55	6·399	16·5	0·649			37·20	25	112·95	4·446	10·3	0·406
		104·17	70	160·65	6·325	14·6	0·575			31·25	21	109·97	4·330	7·3	0·290
		96·73	65	158·74	6·250	12·7	0·500	203·19	8	37·94	25·5	108·48	4·271	13·7	0·541
457·19	18	104·17	70	158·96	6·259	18·2	0·719			34·22	23	106·13	4·179	11·4	0·449
		96·73	65	156·88	6·177	16·1	0·637			30·50	20·5	103·79	4·087	9·0	0·357
		89·29	60	154·80	6·095	14·0	0·555			26·78	18	101·59	4·000	6·8	0·270
		81·85	55	152·39	6·000	11·6	0·460	177·79	7	29·76	20	98·24	3·868	11·6	0·458
380·99	15	148·82	100	172·05	6·774	30·0	1·184			26·04	17·5	95·57	3·763	8·9	0·353
		141·38	95	169·53	6·675	27·5	1·085			22·32	15	92·96	3·660	6·3	0·250
		133·93	90	167·04	6·577	25·0	0·987	152·39	6	25·67	17·25	90·80	3·575	12·0	0·475
		126·49	85	164·55	6·479	22·5	0·889			21·95	14·75	87·67	3·452	8·9	0·352
		119·05	80	162·55	6·400	20·5	0·810			18·23	12·25	84·58	3·330	5·8	0·230
		111·61	75	159·81	6·292	22·4	0·882	126·99	5	21·95	14·75	83·66	3·294	12·8	0·504
		104·17	70	157·32	6·194	19·9	0·784			18·23	12·25	79·92	3·147	9·0	0·357
		96·73	65	154·83	6·096	17·4	0·686			14·51	9·75	76·19	3·000	5·3	0·210
		89·29	60	152·39	6·000	14·9	0·590	101·59	4	15·62	10·5	73·15	2·880	10·4	0·410
		81·85	55	145·94	5·746	16·6	0·656			14·13	9·5	71·30	2·807	8·5	0·337
		74·41	50	143·45	5·648	14·1	0·558			12·64	8·5	69·41	2·733	6·6	0·263
		66·96	45	140·96	5·550	11·6	0·460			11·16	7·5	67·56	2·660	4·8	0·190
		62·50	42	139·69	5·500	10·4	0·410	76·19	3	11·16	7·5	64·02	2·521	9·1	0·361
304·79	12	52·08	35	129·18	5·086	11·1	0·436			9·67	6·5	61·53	2·423	6·6	0·263
		46·87	31·5	126·96	5·000	8·9	0·350			8·18	5·5	59·18	2·330	4·3	0·170

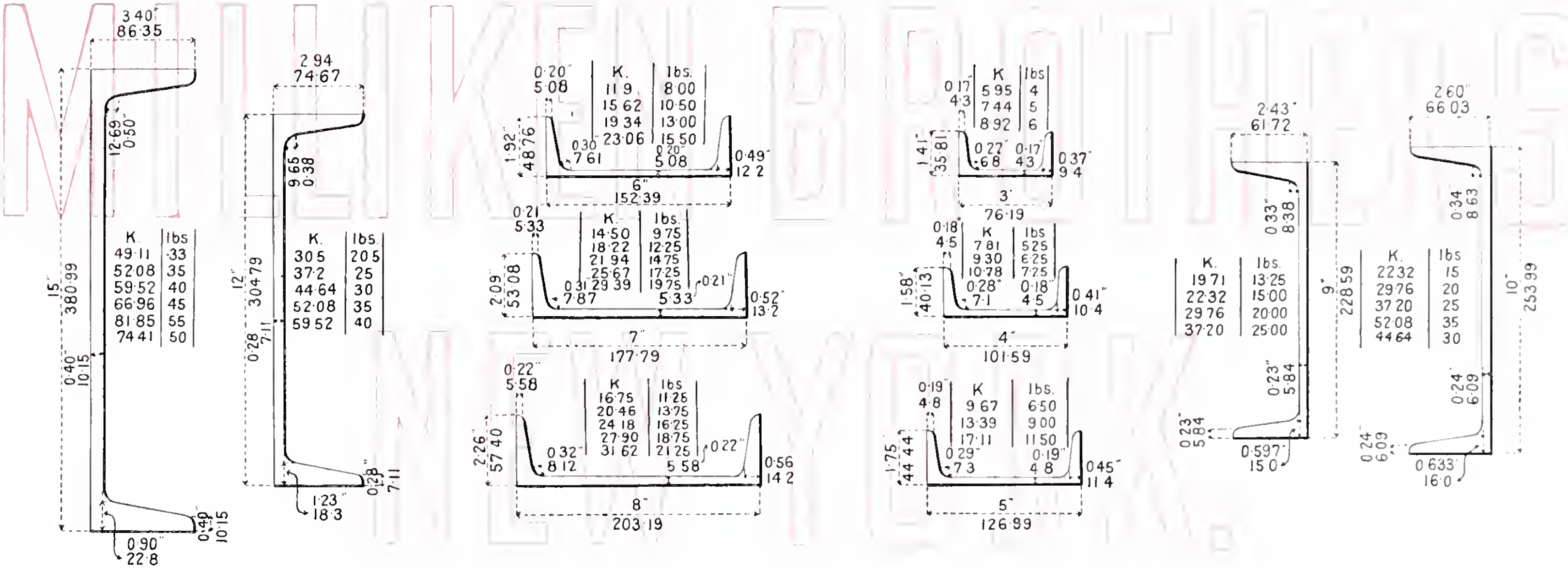
Steel Deck Beams, standard sections.



All dimensions are given in millimetres and inches.
All weights are given in kilogramsper metre and pounds per lineal foot.
All dimensions given are for minimum weight of each section.

Plate No. 8.

Steel Channels, standard sections.



All dimensions are given in millimetres and inches.
All weights are given in kilograms per metre and pounds per lineal foot.
All dimensions given are for minimum weight of each section.

Plate No. 9.

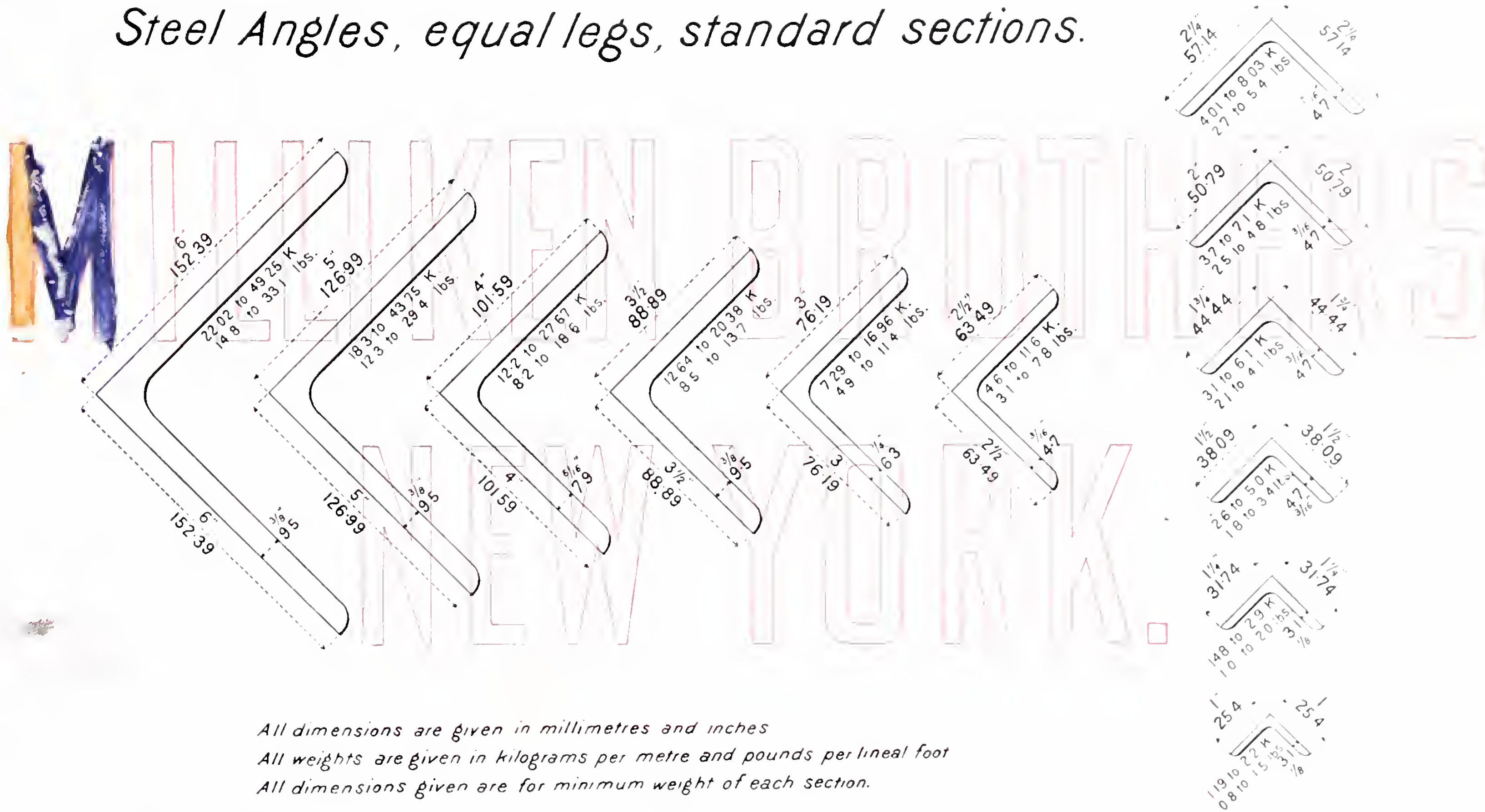
Maximum and minimum weights and dimensions of steel Deck Beams, standard sections.

Depth of beam m.m.	Depth of beam inches	Weight per M. kilograms.		Weight per ft lbs.		Width of flange m.m.		Width of flange inches.		Thickness of web m.m.		Thickness of web inches.	
		minimum.	maximum.	minimum.	maximum.	minimum.	maximum.	minimum.	maximum.	minimum.	maximum.	minimum.	maximum.
253·99	10	40·5	53·13	27·23	35·70	133·34	139·69	5·25	5·50	9·6	16·0	·38	·63
228·59	9	38·7	44·6	26·00	30·00	125·47	128·77	4·94	5·07	11·1	14·4	·44	·57
203·19	8	30·0	36·4	20·15	24·48	126·99	131·06	5·00	5·16	7·8	11·9	·31	·47
177·79	7	26·9	34·9	18·11	23·46	123·80	129·53	4·87	5·10	7·8	13·7	·31	·54
152·39	6	22·7	27·3	15·30	18·36	111·12	115·05	4·38	4·53	7·1	10·9	·28	·43

Maximum, intermediate and minimum weights and dimensions of steel Channels, standard sections.

Depth of Channel m.m.	Depth of Channel ins.	Weight per M. Kilograms.	Weight per ft. lbs.	Width of flange m.m.	Width of flange inches	Thickness of web m.m.	Thickness of web ins.	Depth of Channel m.m.	Depth of Channel ins.	Weight per M. Kilograms.	Weight per ft. lbs.	Width of flange m.m.	Width of flange inches	Thickness of web m.m.	Thickness of web ins.
380·99	15	81·85	55·00	96·97	3·818	20·77	0·818	203·19	8	24·18	16·25	61·97	2·439	10·15	0·399
380·99	15	74·41	50·00	94·48	3·720	18·28	0·720	203·19	8	20·46	13·75	59·61	2·347	7·87	0·307
380·99	15	66·96	45·00	91·99	3·622	15·79	0·622	203·19	8	16·74	11·25	57·40	2·260	5·58	0·220
380·99	15	59·52	40·00	89·50	3·524	13·30	0·524	177·79	7	29·39	19·75	63·82	2·513	16·07	0·633
380·99	15	52·08	35·00	87·01	3·426	10·81	0·426	177·79	7	25·67	17·25	61·21	2·408	13·46	0·528
380·99	15	49·11	33·00	86·35	3·400	10·15	0·400	177·79	7	21·95	14·75	58·49	2·303	10·67	0·423
304·79	12	59·52	40·00	86·81	3·418	19·24	0·758	177·79	7	18·23	12·25	55·87	2·198	8·12	0·318
304·79	12	52·08	35·00	83·71	3·296	16·15	0·636	177·79	7	14·50	9·75	53·08	2·090	5·33	0·210
304·79	12	44·64	30·00	80·58	3·173	13·02	0·513	152·39	6	23·06	15·50	57·98	2·283	14·22	0·563
304·79	12	37·20	25·00	77·46	3·050	9·90	0·390	152·39	6	19·34	13·00	54·86	2·160	11·17	0·440
304·79	12	30·50	20·50	74·67	2·940	7·11	0·280	152·39	6	15·62	10·50	51·81	2·038	8·12	0·318
253·99	10	52·08	35·00	80·84	3·183	20·90	0·823	152·39	6	11·90	8·00	48·76	1·920	5·07	0·200
253·99	10	44·64	30·00	77·12	3·036	17·17	0·676	126·99	5	17·11	11·50	51·81	2·037	12·19	0·477
253·99	10	37·20	25·00	73·40	2·889	13·46	0·529	126·99	5	13·39	9·00	48·00	1·890	8·38	0·330
253·99	10	29·76	20·00	69·64	2·742	9·65	0·382	126·99	5	9·67	6·50	44·44	1·750	4·82	0·190
253·99	10	22·32	15·00	66·03	2·600	6·09	0·240	101·59	4	10·78	7·25	43·81	1·725	8·38	0·325
228·59	9	37·20	25·00	71·49	2·815	15·74	0·615	101·59	4	9·30	6·25	41·27	1·625	6·34	0·252
228·59	9	29·76	20·00	67·35	2·652	11·42	0·452	101·59	4	7·81	5·25	40·13	1·580	4·57	0·180
228·59	9	22·32	15·00	63·24	2·488	7·36	0·288	76·19	3	8·92	6·00	40·68	1·602	9·14	0·362
228·59	9	19·71	13·25	61·72	2·430	5·80	0·230	76·19	3	7·44	5·00	38·19	1·504	6·60	0·264
203·19	8	31·62	21·25	66·54	2·622	14·73	0·582	76·19	3	5·95	4·00	35·81	1·410	4·31	0·170
203·19	8	27·90	18·75	64·26	2·530	12·44	0·490								

Steel Angles, equal legs, standard sections.



All dimensions are given in millimetres and inches
All weights are given in kilograms per metre and pounds per lineal foot
All dimensions given are for minimum weight of each section.

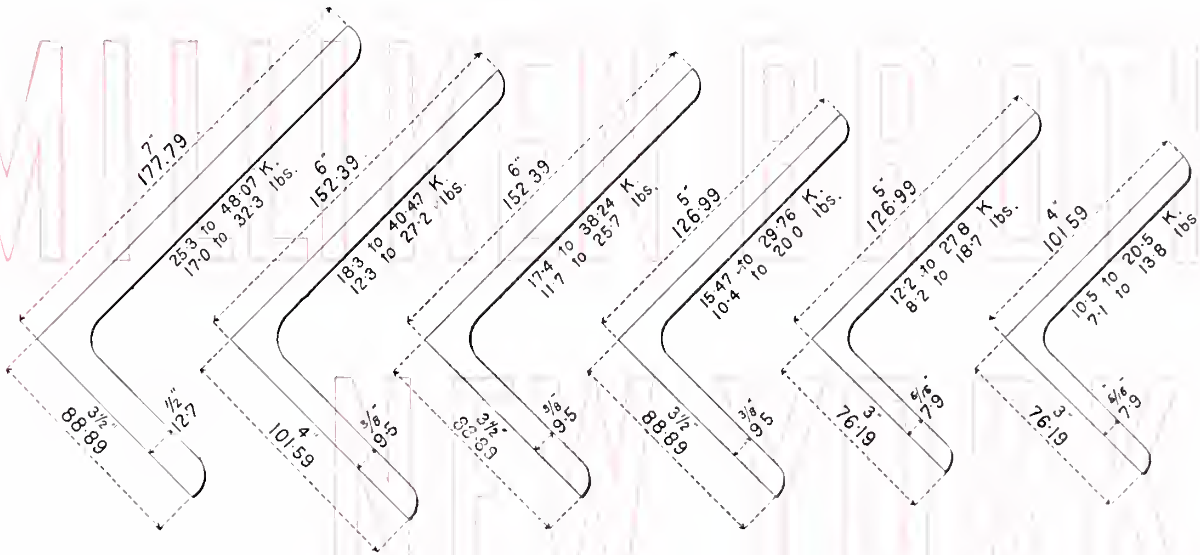
Plate No. 11.

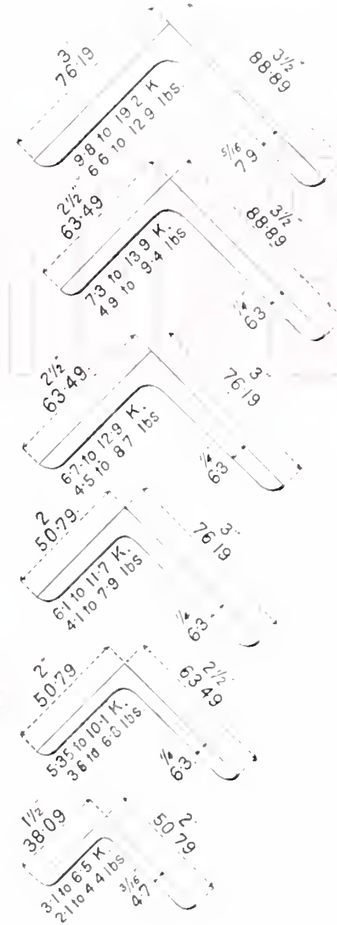
Maximum intermediate and minimum weights and dimensions of steel Angles of standard sections.

Equal legs.

Thickness m.m.	Thickness ins	Size m m	Size ins.	Weight per M Kilograms	Weight per ft. lbs	Thickness m.m.	Thickness ins.	Size m m.	Size ins.	Weight per M Kilograms.	Weight per ft lbs	Thickness m.m.	Thickness ins	Size m.m.	Size ins.	Weight per M. Kilograms	Weight per ft lbs.	Thickness m.m.	Thickness ins	Size m.m.	Size ins.	Weight per M. Kilograms	Weight per ft lbs
9·5	3/8	152·39×152·39	6×6	22·02	14·8	7·9	5/16	101·59×101·59	4×4	12·20	8·2	4·7	3/16	63·49×63·49	2½×2½	4·60	3·1	4·7	3/16	38·09×38·09	1½×1½	2·67	1·8
11·17	7/16	152·39×152·39	6×6	25·59	17·2	9·5	3/8	101·59×101·59	4×4	14·58	9·8	6·3	1/4	63·49×63·49	2½×2½	6·10	4·1	6·3	1/4	38·09×38·09	1½×1½	3·57	2·4
12·70	1/2	152·39×152·39	6×6	29·16	19·6	11·17	7/16	101·59×101·59	4×4	16·81	11·3	7·9	5/16	63·49×63·49	2½×2½	7·44	5·0	7·9	5/16	38·09×38·09	1½×1½	4·31	2·9
14·22	9/16	152·39×152·39	6×6	32·59	21·9	12·70	1/2	101·59×101·59	4×4	19·04	12·8	9·5	3/8	63·49×63·49	2½×2½	8·78	5·9	9·5	3/8	38·09×38·09	1½×1½	5·05	3·4
16·00	5/8	152·39×152·39	6×6	36·01	24·2	14·22	9/16	101·59×101·59	4×4	21·28	14·3	11·17	7/16	63·49×63·49	2½×2½	10·26	6·8						
17·52	11/16	152·39×152·39	6×6	39·43	26·5	16·00	5/8	101·59×101·59	4×4	23·36	15·7	12·70	1/2	63·49×63·49	2½×2½	11·60	7·7						
19·04	3/4	152·39×152·39	6×6	42·71	28·7	17·52	11/16	101·59×101·59	4×4	25·44	17·1												
20·57	13/16	152·39×152·39	6×6	45·98	30·9	19·04	3/4	101·59×101·59	4×4	27·67	18·5												
22·35	7/8	152·39×152·39	6×6	49·25	33·1							4·7	3/16	57·14×57·14	2¼×2¼	4·01	2·8						
						9·5	3/8	88·89×88·89	3½×3½	12·64	8·5	6·3	1/4	57·14×57·14	2¼×2¼	5·35	3·6						
						11·17	7/16	88·89×88·89	3½×3½	14·58	9·8	7·9	5/16	57·14×57·14	2¼×2¼	6·69	4·5	3·1	1/8	31·74×31·74	1¼×1¼	1·48	1·0
						12·70	1/2	88·89×88·89	3½×3½	16·51	11·1	9·5	3/8	57·14×57·14	2¼×2¼	8·03	5·4	4·7	3/16	31·74×31·74	1¼×1¼	2·23	1·5
9·5	3/8	126·99×126·99	5×5	18·30	12·3	14·22	9/16	88·89×88·89	3½×3½	18·30	12·3							6·3	1/4	31·74×31·74	1¼×1¼	2·90	1·9
11·17	7/16	126·99×126·99	5×5	21·28	14·3	16·00	5/8	88·89×88·89	3½×3½	20·38	13·6	4·7	3/16	50·79×50·79	2×2	3·70	2·5						
12·70	1/2	126·99×126·99	5×5	24·10	16·2							6·3	1/4	50·79×50·79	2×2	4·76	3·2						
14·22	9/16	126·99×126·99	5×5	26·93	18·1	6·3	1/4	76·19×76·19	3×3	7·29	4·9	7·9	5/16	50·79×50·79	2×2	5·95	4·0						
16·00	5/8	126·99×126·99	5×5	29·91	20·0	7·9	5/16	76·19×76·19	3×3	9·07	6·1	9·5	3/8	50·79×50·79	2×2	7·14	4·8						
17·52	11/16	126·99×126·99	5×5	32·74	21·8	9·5	3/8	76·19×76·19	3×3	10·71	7·2												
19·04	3/4	126·99×126·99	5×5	35·41	23·6	11·17	7/16	76·19×76·19	3×3	12·35	8·3	4·7	3/16	44·44×44·44	1¾×1¾	3·12	2·1						
20·57	13/16	126·99×126·99	5×5	38·09	25·4	12·70	1/2	76·19×76·19	3×3	13·98	9·4	6·3	1/4	44·44×44·44	1¾×1¾	4·16	2·8	3·1	1/8	25·4×25·4	1×1	1·19	0·8
22·35	7/8	126·99×126·99	5×5	40·77	27·2	14·22	9/16	76·19×76·19	3×3	15·47	10·4	7·9	5/16	44·44×44·44	1¾×1¾	5·05	3·4	4·7	3/16	25·4×25·4	1×1	1·78	1·2
23·87	15/16	126·99×126·99	5×5	43·75	29·4	16·00	5/8	76·19×76·19	3×3	16·96	11·4	9·5	3/8	44·44×44·44	1¾×1¾	6·10	4·1	6·3	1/4	25·4×25·4	1×1	2·23	1·5

Steel Angles, unequal legs, standard sections.





All dimensions are given in millimetres, and inches.
All weights are given in kilograms per metre and pounds per lineal foot.
All dimensions given are for minimum weight of each section.

Plate No. 13.

Maximum, intermediate and minimum weights and dimensions of steel Angles of standard sections.

Unequal legs.

Thickness m.m.	Thickness ins.	Size m.m.	Size ins.	Weight per M. Kilograms.	Weight per ft. lbs.
12.7	½	177.79×88.89	7×3½	25.30	17.0
14.22	9/16	177.79×88.89	7×3½	28.27	19.0
16.00	⅝	177.79×88.89	7×3½	31.25	21.0
17.52	11/16	177.79×88.89	7×3½	34.22	23.0
19.04	¾	177.79×88.89	7×3½	36.90	24.9
20.57	13/16	177.79×88.89	7×3½	39.73	26.8
22.35	⅞	177.79×88.89	7×3½	42.56	28.7
23.80	15/16	177.79×88.89	7×3½	45.39	30.5
25.40	1	177.79×88.89	7×3½	48.07	32.3
9.5	⅜	152.39×101.59	6×4	18.3	12.3
11.17	7/16	152.39×101.59	6×4	21.28	14.3
12.70	½	152.39×101.59	6×4	24.25	16.2
14.22	9/16	152.39×101.59	6×4	26.93	18.1
16.00	⅝	152.39×101.59	6×4	29.76	20.0
17.52	11/16	152.39×101.59	6×4	32.74	21.8
19.04	¾	152.39×101.59	6×4	35.41	23.6
20.57	13/16	152.39×101.59	6×4	38.09	25.4
22.35	⅞	152.39×101.59	6×4	40.47	27.2
9.5	⅜	152.39×88.89	6×3½	17.40	11.7
11.17	7/16	152.39×88.89	6×3½	20.09	13.5

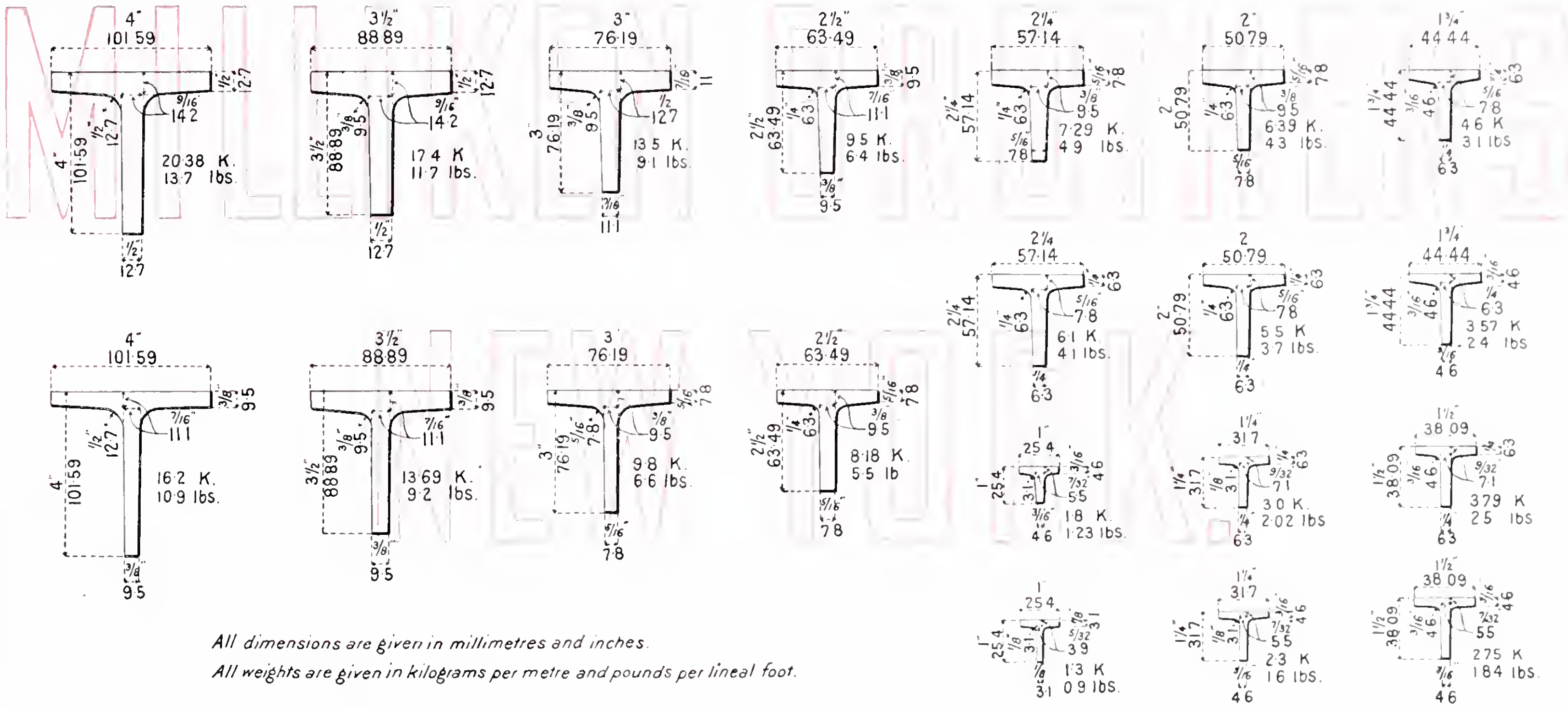
Thickness m.m.	Thickness ins.	Size m.m.	Size ins.	Weight per M. Kilograms.	Weight per ft. lbs.
12.70	½	152.39×88.89	6×3½	22.76	15.3
14.22	9/16	152.39×88.89	6×3½	25.44	17.1
16.00	⅝	152.39×88.89	6×3½	28.12	18.9
17.52	11/16	152.39×88.89	6×3½	30.65	20.6
19.04	¾	152.39×88.89	6×3½	33.18	22.3
20.57	13/16	152.39×88.89	6×3½	35.71	24.0
22.35	⅞	152.39×88.89	6×3½	38.24	25.7
9.5	⅜	126.99×88.89	5×3½	15.47	10.4
11.17	7/16	126.99×88.89	5×3½	17.85	12.0
12.70	½	126.99×88.89	5×3½	20.23	13.6
14.22	9/16	126.99×88.89	5×3½	22.63	15.2
16.00	⅝	126.99×88.89	5×3½	25.00	16.8
17.52	11/16	126.99×88.89	5×3½	27.23	18.3
19.04	¾	126.99×88.89	5×3½	29.76	19.8
7.9	5/16	126.99×76.19	5×3	12.2	8.2
9.5	⅜	126.99×76.19	5×3	14.43	9.7
11.17	7/16	126.99×76.19	5×3	16.66	11.3
12.70	½	126.99×76.19	5×3	19.04	12.8
14.22	9/16	126.99×76.19	5×3	21.13	14.2
16.00	⅝	126.99×76.19	5×3	23.36	15.7

Thickness m.m.	Thickness ins.	Size m.m.	Size ins.	Weight per M. Kilograms.	Weight per ft. lbs.
17.52	11/16	126.99×76.19	5×3	25.44	17.1
19.04	¾	126.99×76.19	5×3	27.82	18.5
7.9	5/16	101.59×76.19	4×3	10.56	7.1
9.5	⅜	101.59×76.19	4×3	12.64	8.5
11.17	7/16	101.59×76.19	4×3	14.58	9.8
12.70	½	101.59×76.19	4×3	16.51	11.1
14.22	9/16	101.59×76.19	4×3	18.30	12.3
16.00	⅝	101.59×76.19	4×3	20.50	13.6
7.9	5/16	88.89×76.19	3½×3	9.8	6.6
9.5	⅜	88.89×76.19	3½×3	11.60	7.8
11.17	7/16	88.89×76.19	3½×3	13.54	9.1
12.70	½	88.89×76.19	3½×3	15.32	10.2
14.22	9/16	88.89×76.19	3½×3	16.96	11.4
16.00	⅝	88.89×76.19	3½×3	19.20	12.9
6.3	¼	88.89×63.49	3½×2½	7.29	4.9
7.9	5/16	88.89×63.49	3½×2½	9.07	6.1
9.5	⅜	88.89×63.49	3½×2½	10.72	7.2
11.17	7/16	88.89×63.49	3½×2½	12.35	8.3
12.70	½	88.89×63.49	3½×2½	13.98	9.4

Thickness m.m.	Thickness ins.	Size m.m.	Size ins.	Weight per M. Kilograms.	Weight per ft. lbs.
6.3	¼	76.19×50.79	3×2	6.10	4.1
7.9	5/16	76.19×50.79	3×2	7.44	5.0
9.5	⅜	76.19×50.79	3×2	8.78	5.9
11.17	7/16	76.19×50.79	3×2	10.11	6.8
12.70	½	76.19×50.79	3×2	11.7	7.7
6.3	¼	76.19×63.49	3×2½	6.7	4.5
7.9	5/16	76.19×63.49	3×2½	8.18	5.5
9.5	⅜	76.19×63.49	3×2½	9.82	6.6
11.17	7/16	76.19×63.49	3×2½	11.45	7.6
12.70	½	76.19×63.49	3×2½	12.9	8.5
6.3	¼	63.49×50.79	2½×2	5.35	3.6
7.9	5/16	63.49×50.79	2½×2	6.69	4.5
9.5	⅜	63.49×50.79	2½×2	8.03	5.3
11.17	7/16	63.49×50.79	2½×2	9.22	6.1
12.70	½	63.49×50.79	2½×2	10.1	6.8
4.7	3/16	50.79×38.09	2×1½	3.12	2.1
6.3	¼	50.79×38.09	2×1½	4.31	2.9
7.9	5/16	50.79×38.09	2×1½	5.35	3.6
9.5	⅜	50.79×38.09	2×1½	6.50	4.4

Plate No. 14.

Steel Tees, standard sections.
Equal legs.



All dimensions are given in millimetres and inches.

All weights are given in kilograms per metre and pounds per lineal foot.

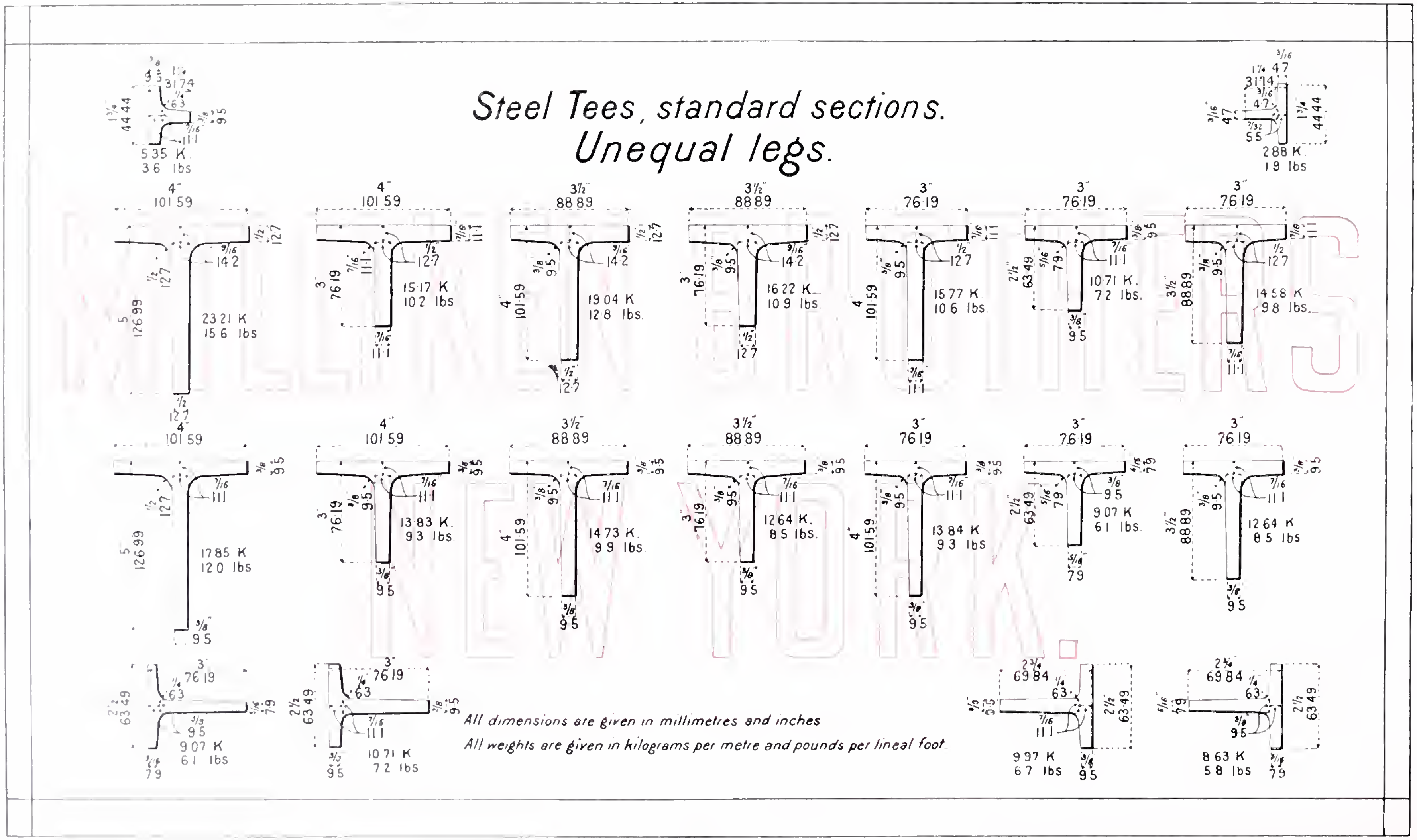

Steel Tees, standard sections.
Unequal legs.
5.35 K. 3.6 lbs
2.88 K. 1.9 lbs
23.21 K 15.6 lbs
15.17 K 10.2 lbs
19.04 K 12.8 lbs.
16.22 K. 10.9 lbs.
15.77 K. 10.6 lbs.
10.71 K. 7.2 lbs.
14.58 K 9.8 lbs.
17.85 K 12.0 lbs
13.83 K. 9.3 lbs.
14.73 K. 9.9 lbs.
12.64 K. 8.5 lbs.
13.84 K. 9.3 lbs
9.07 K 6.1 lbs.
12.64 K 8.5 lbs
9.07 K 6.1 lbs
10.71 K 7.2 lbs
9.97 K 6.7 lbs
8.63 K 5.8 lbs
All dimensions are given in millimetres and inches
All weights are given in kilograms per metre and pounds per lineal foot

Plate No. 16.

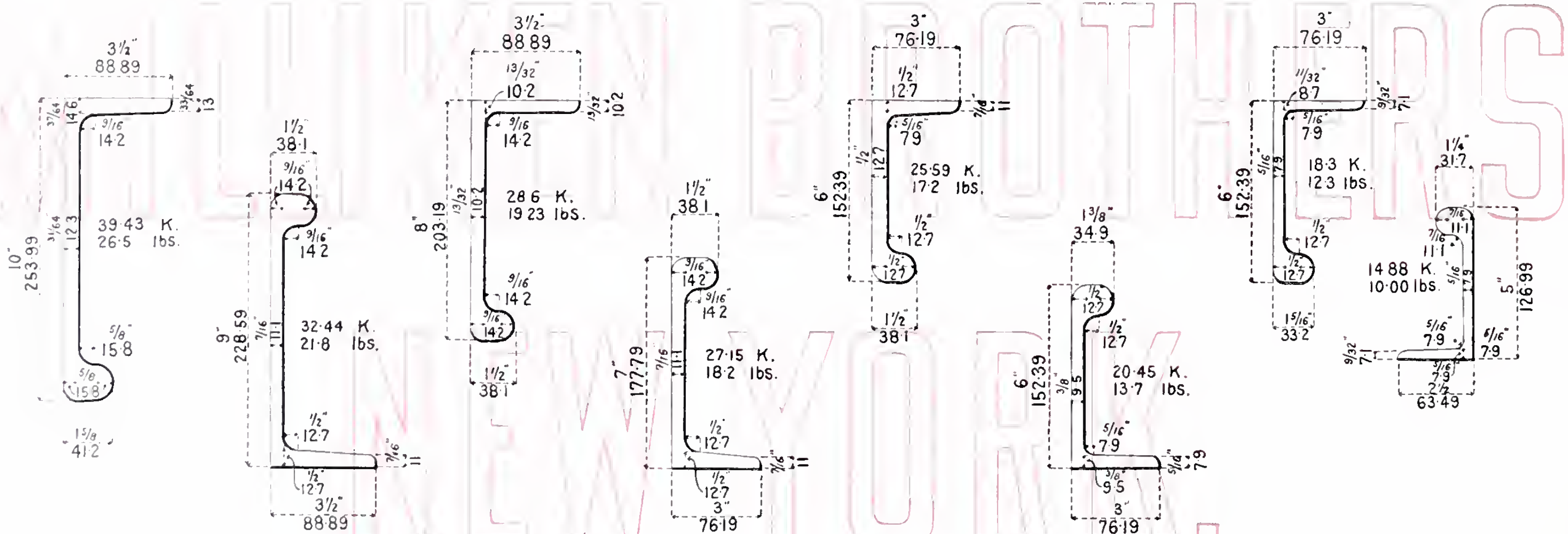
Weights and dimensions of steel Tees standard sections.
Equal legs.

Size in m m		Size in ins.		Thickness m.m.	Thickness ins.	Weight per M Kilograms	Weight per ft. lbs.	Size in m m.		Size in ins.		Thickness m.m	Thickness ins.	Weight per M. Kilograms.	Weight per ft lbs
Flange	Stem	Flange.	Stem.					Flange.	Stem.	Flange.	Stem				
101·59	101·59	4	4	12·7 to 14·2	½ to 9/16	20·38	13·7	50·79	50·79	2	2	7·8 to 9·5	5/16 to 3/8	6·39	4·3
101·59	101·59	4	4	9·5 to 11·1	3/8 to 7/16	16·20	10·9	50·79	50·79	2	2	6·3 to 7·8	¼ to 5/16	5·5	3·8
88·89	88·89	3½	3½	12·7 to 14·2	½ to 9/16	17·40	11·7	44·44	44·44	1¾	1¾	6·3 to 7·8	¼ to 5/16	4·60	3·1
88·89	88·89	3½	3½	9·5 to 11·1	3/8 to 7/16	13·69	9·2	44·44	44·44	1¾	1¾	4·6 to 6·3	3/16 to ¼	3·57	2·4
76·19	76·19	3	3	11·1 to 12·7	7/16 to ½	13·50	9·1	38·09	38·09	1½	1½	6·3 to 7·1	¼ to 9/32	3·79	2·5
76·19	76·19	3	3	7·8 to 9·5	5/16 to 3/8	9·80	6·6	38·09	38·09	1½	1½	4·6 to 5·5	3/16 to 7/32	2·87	1·9
63·49	63·49	2½	2½	9·5 to 11·1	3/8 to 7/16	9·50	6·4	31·7	31·7	1¼	1¼	6·3 to 7·1	¼ to 9/32	3·0	2·0
63·49	63·49	2½	2½	7·8 to 9·5	5/16 to 3/8	8·18	5·5	31·7	31·7	1¼	1¼	4·6 to 5·5	3/16 to 7/32	2·3	1·6
57·14	57·14	2¼	2¼	7·8 to 9·5	5/16 to 3/8	7·29	4·9	25·4	25·4	1	1	4·6 to 5·5	3/16 to 7/32	1·8	1·2
57·14	57·14	2¼	2¼	6·3 to 7·8	¼ to 5/16	6·10	4·1	25·4	25·4	1	1	3·1 to 3·9	⅛ to 5/32	1·3	0·9

Weights and dimensions of steel Tees standard sections.
Unequal legs.

Size in m.m.		Size in ins.		Thickness m.m.	Thickness ins.	Weight per M Kilograms	Weight per ft. lbs.	Size in m.m.		Size in ins.		Thickness m.m.	Thickness ins.	Weight per M. Kilograms	Weight per ft. lbs
Flange.	Stem.	Flange.	Stem.					Flange.	Stem.	Flange.	Stem.				
101·59	126·99	4	5	12·7 to 14·2	½ to 9/16	23·21	15·6	76·19	88·89	3	3½	11·1 to 12·7	7/16 to ½	14·58	9·8
101·59	126·99	4	5	9·5 to 11·1	3/8 to 7/16	17·85	12·0	76·19	88·89	3	3½	9·5 to 11·1	3/8 to 7/16	12·64	8·5
101·59	76·19	4	3	9·5 to 11·1	3/8 to 7/16	13·83	9·3	76·19	63·49	3	2½	9·5 to 11·1	3/8 to 7/16	10·71	7·2
101·59	76·19	4	3	11·1 to 12·7	7/16 to ½	15·17	10·2	76·19	63·49	3	2½	7·9 to 9·5	5/16 to 3/8	9·07	6·1
88·89	101·59	3½	4	12·7 to 14·2	½ to 9/16	19·04	12·8	63·49	76·19	2½	3	9·5 to 11·1	3/8 to 7/16	10·71	7·2
88·89	101·59	3½	4	9·5 to 11·1	3/8 to 7/16	14·73	9·9	63·49	76·19	2½	3	7·9 to 9·5	5/16 to 3/8	9·07	6·1
88·89	76·19	3½	3	12·7 to 14·2	½ to 9/16	16·22	10·9	63·49	69·84	2½	2¾	9·5 to 11·1	3/8 to 7/16	9·97	6·7
88·89	76·19	3½	3	9·5 to 11·1	3/8 to 7/16	12·64	8·5	63·49	69·84	2½	2¾	7·9 to 9·5	5/16 to 3/8	8·63	5·8
76·19	101·59	3	4	11·1 to 12·7	7/16 to ½	15·77	10·6	44·44	31·74	1¾	1¼	9·5 to 11·1	3/8 to 7/16	5·35	3·6
76·19	101·59	3	4	9·5 to 11·1	3/8 to 7/16	13·84	9·3	44·44	31·74	1¾	1¼	4·7 to 5·5	3/16 to 7/32	2·88	1·9

Steel bulb Angles, standard sections.

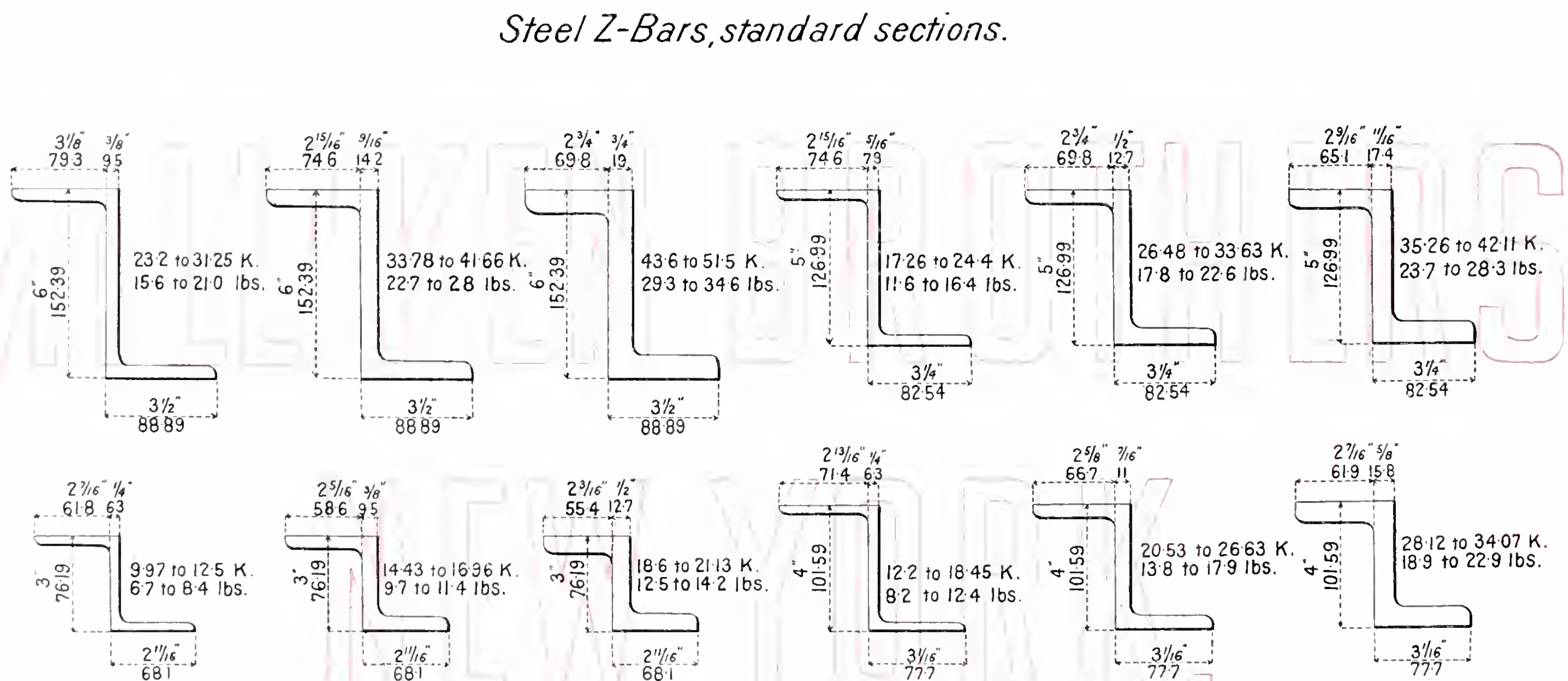


All dimensions are given in millimetres and inches
All weights are given in kilograms per metre and pounds per lineal foot.

Weights and dimensions of Bulb Angles.
Standard sections.

Depth of Angle m.m.	Depth of Angle ins	Weight per M. Kg.	Weight per ft. lbs.	Flange Width m.m.	Flange Width ins	Web Thickness m.m	Web Thickness ins.
253·99	10	39·43	26·50	88·89	3½	12·2	0·48
228·59	9	32·44	21·80	88·89	3½	11·1	0·44
203·19	8	28·60	19·23	88·89	3½	10·2	0·41
177·79	7	27·15	18·25	76·19	3	11·1	0·44
152·39	6	25·59	17·20	76·19	3	12·7	0·50
152·39	6	20·45	13·75	76·19	3	9·6	0·38
152·39	6	18·30	12·30	76·19	3	7·9	0·31
126·99	5	14·88	10	63·49	2½	7·9	0·31

Plate No. 19.



All dimensions are given in millimetres and inches.
All weights are given in kilograms per metre and pounds per lineal foot.
All dimensions given are for minimum weight of each section.

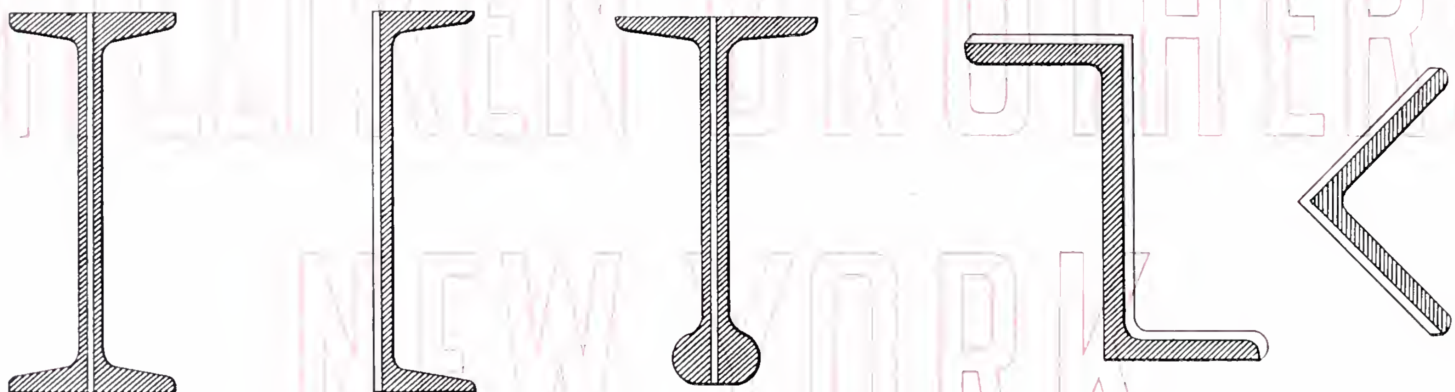
Plate No. 20.

Maximum intermediate and minimum weights and dimensions of steel Z-Bars standard sections.

Thickness m m.	Thickness ins	Actual size in m.m			Actual size in ins.			Weight per M Kilograms.	Weight per ft lbs.
		Flange	Web.	Flange.	Flange	Web	Flange.		
6·34	1/4	68·27	76·19	68·27	2 11/16	3	2 11/16	9·97	6·7
7·94	5/16	69·84	77·78	69·84	2 3/4	3 1/16	2 3/4	12·50	8·4
9·50	3/8	68·27	76·19	68·27	2 11/16	3	2 11/16	14·43	9·7
11·11	7/16	69·84	77·78	69·84	2 3/4	3 1/16	2 3/4	16·96	11·4
12·70	1/2	68·27	76·19	68·27	2 11/16	3	2 11/16	18·60	12·5
14·28	9/16	69·84	77·78	69·84	2 3/4	3 1/16	2 3/4	21·13	14·2
6·34	1/4	77·78	101·59	77·78	3 1/16	4	3 1/16	12·20	8·2
7·94	5/16	79·36	103·18	79·36	3 1/8	4 1/16	3 1/8	15·32	10·3
9·50	3/8	81·02	104·77	81·02	3 3/16	4 1/8	3 3/16	18·45	12·4
11·11	7/16	77·78	101·59	77·78	3 1/16	4	3 1/16	20·53	13·8
12·70	1/2	79·36	103·18	79·36	3 1/8	4 1/16	3 1/8	23·51	15·8
14·28	9/16	81·02	104·77	81·02	3 3/16	4 1/8	3 3/16	26·63	17·9
15·87	5/8	77·78	101·59	77·78	3 1/16	4	3 1/16	28·12	18·9
17·46	11/16	79·36	103·18	79·36	3 1/8	4 1/16	3 1/8	31·10	20·9
19·04	3/4	81·02	104·77	81·02	3 3/16	4 1/8	3 3/16	34·07	22·9
7·94	5/16	82·54	126·99	82·54	3 1/4	5	3 1/4	17·26	11·6
9·50	3/8	84·07	128·52	84·07	3 5/16	5 1/16	3 5/16	20·68	13·9
11·11	7/16	85·69	130·18	85·69	3 3/8	5 1/8	3 3/8	24·40	16·4
12·70	1/2	82·54	126·99	82·54	3 1/4	5	3 1/4	26·48	17·8
14·28	9/16	84·07	128·52	84·07	3 5/16	5 1/16	3 5/16	30·06	20·2
15·87	5/8	85·69	130·18	85·69	3 3/8	5 1/8	3 3/8	33·63	22·6
17·46	11/16	82·54	126·99	82·54	3 1/4	5	3 1/4	35·26	23·7
19·04	3/4	84·07	128·52	84·07	3 5/16	5 1/16	3 5/16	38·69	26·0
20·63	13/16	85·69	130·18	85·69	3 3/8	5 1/8	3 3/8	42·11	28·3
9·50	3/8	88·89	152·39	88·89	3 1/2	6	3 1/2	23·21	15·6
11·11	7/15	90·42	153·92	90·42	3 9/16	6 1/16	3 9/16	27·23	18·3
12·70	1/2	91·94	155·57	91·94	3 5/8	6 1/8	3 5/8	31·25	21·0
14·28	9/16	88·89	152·39	88·89	3 1/2	6	3 1/2	33·78	22·7
15·87	5/8	90·42	153·92	90·42	3 9/16	6 1/16	3 9/16	37·80	25·4
17·46	11/16	91·94	155·57	91·94	3 5/8	6 1/8	3 5/8	41·66	28·0
19·04	3/4	88·89	152·39	88·89	3 1/2	6	3 1/2	43·60	29·3
20·63	13/16	90·42	153·92	90·42	3 9/16	6 1/16	3 9/16	47·62	32·0
22·22	7/8	91·94	155·57	91·94	3 5/8	6 1/8	3 5/8	51·50	34·6

Plate No. 21.

Method of increasing sectional areas.



The cross hatched portions represent the minimum sections and the blank portions the added areas.

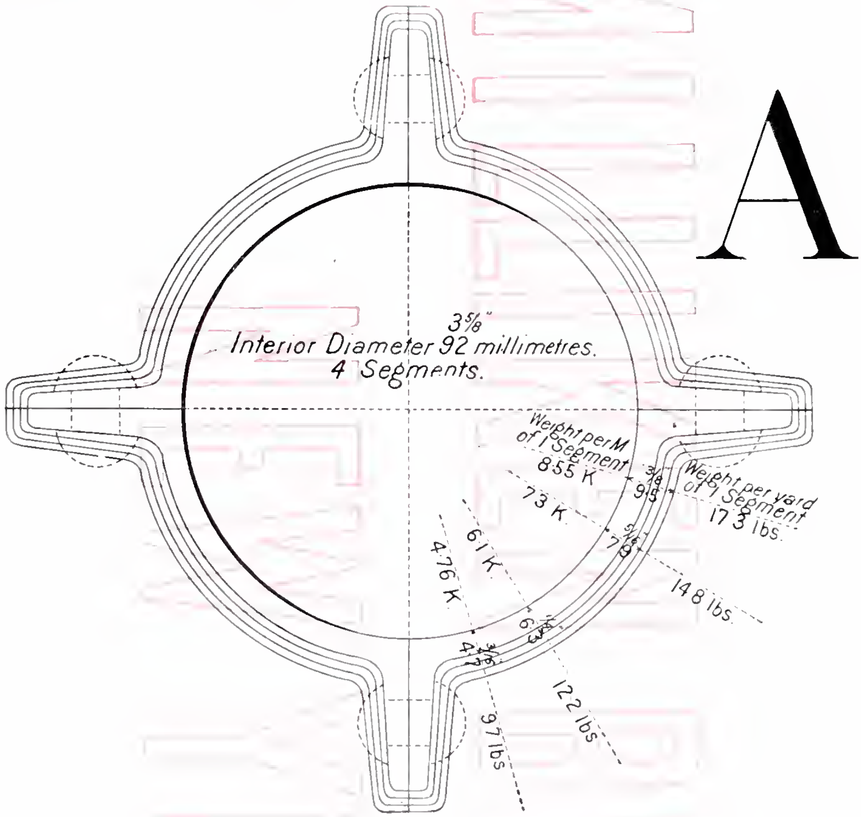


Table of dimensions for Phœnix Columns_Segments "A".

Thickness		d		D		D1		D2		D3		One Column.							
												Area		Weight per M Kg	Weight per ft lbs	Least Rad Gyr		Diameter of rivets.	
mm	ins	mm	ins	mm	ins	mm	ins	mm	ins	mm	ins	sq cm	sq ins			mm	ins.	mm	ins
4 76	3/16	92 07	3 5/8	101 6	4	153 9	6 1/16	112 6	4 7/16	63 5	2 1/2	24 5	3 8	19 0	12 9	36 8	1 45	9 5	3/8
6 34	1/4	92 07	3 5/8	104 7	4 1/8	157·0	6 3/16	115 2	4 9/16	63 5	2 1/2	30 9	4 8	24 3	16 3	38 1	1 5	9 5	3/8
7 93	5/16	92 07	3 5/8	107 9	4 1/4	160·3	6 5/16	119 0	4 11/16	63 5	2 1/2	37 4	5 8	29 3	19 7	39 3	1 55	9 5	3/8
9 52	3/8	92 07	3 5/8	111 1	4 3/8	163 5	6 7/16	122 0	4 13/16	63 5	2 1/2	43 8	6 8	34 2	23 1	40 4	1 59	9 5	3/8

Plate No. 23.

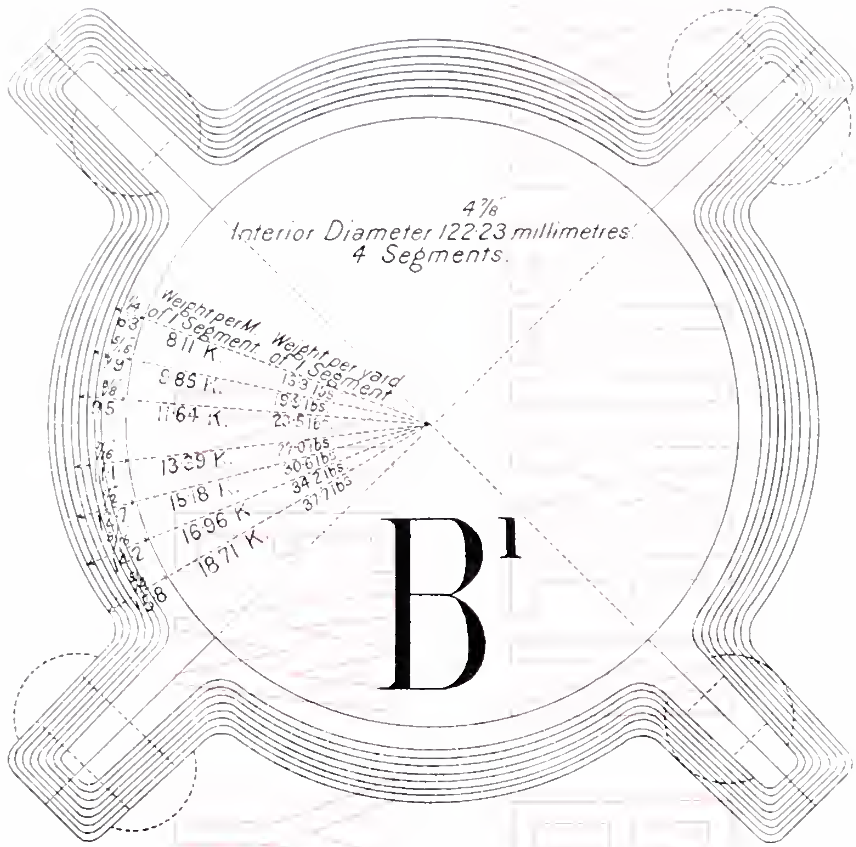


Table of dimensions for Phœnix Columns._ Segments "B1."

Thickness		d.		D		D1		D2		D3		One Column: Area		Weight per M Kg	Weight per ft lbs	Least Radius of Gyration		Diameter of rivets	
mm.	ins.	mm	ins.	mm.	ins.	mm.	ins.	mm	ins.	mm.	ins	sq.c.m.	sq ins			mm.	ins.	mm.	ins.
6·3	1/4	123·82	4 7/8	136·52	5 3/8	206·37	8 1/8	152·39	6	86·51	3 7/16	41·28	6·4	32·44	21·8	49·5	1·95	12·7	1/2
7·9	5/16	123·82	4 7/8	139·69	5 1/2	207·95	8 3/16	155·57	6 1/8	86·51	3 7/16	50·32	7·8	39·43	26·5	50·8	2·00	12·7	1/2
9·5	3/8	123·82	4 7/8	142·87	5 5/8	211·13	8 5/16	158·74	6 1/4	86·51	3 7/16	59·35	9·2	46·58	31·3	51·8	2·04	12·7	1/2
11·1	7/16	123·82	4 7/8	146·04	5 3/4	214·30	8 7/16	161·92	6 3/8	86·51	3 7/16	68·38	10·6	53·57	36·0	53·0	2·09	12·7	1/2
12·7	1/2	123·82	4 7/8	149·22	5 7/8	215·89	8 1/2	165·09	6 1/2	86·51	3 7/16	77·41	12·0	60·71	40·8	54·1	2·13	12·7	1/2
14·2	9/16	123·82	4 7/8	152·39	6	217·48	8 9/16	168·27	6 5/8	86·51	3 7/16	86·44	13·4	67·86	45·6	55·3	2·18	12·7	1/2
15·8	5/8	123·82	4 7/8	155·57	6 1/8	220·65	8 11/16	171·44	6 3/4	86·51	3 7/16	95·47	14·8	74·85	50·3	56·6	2·23	12·7	1/2

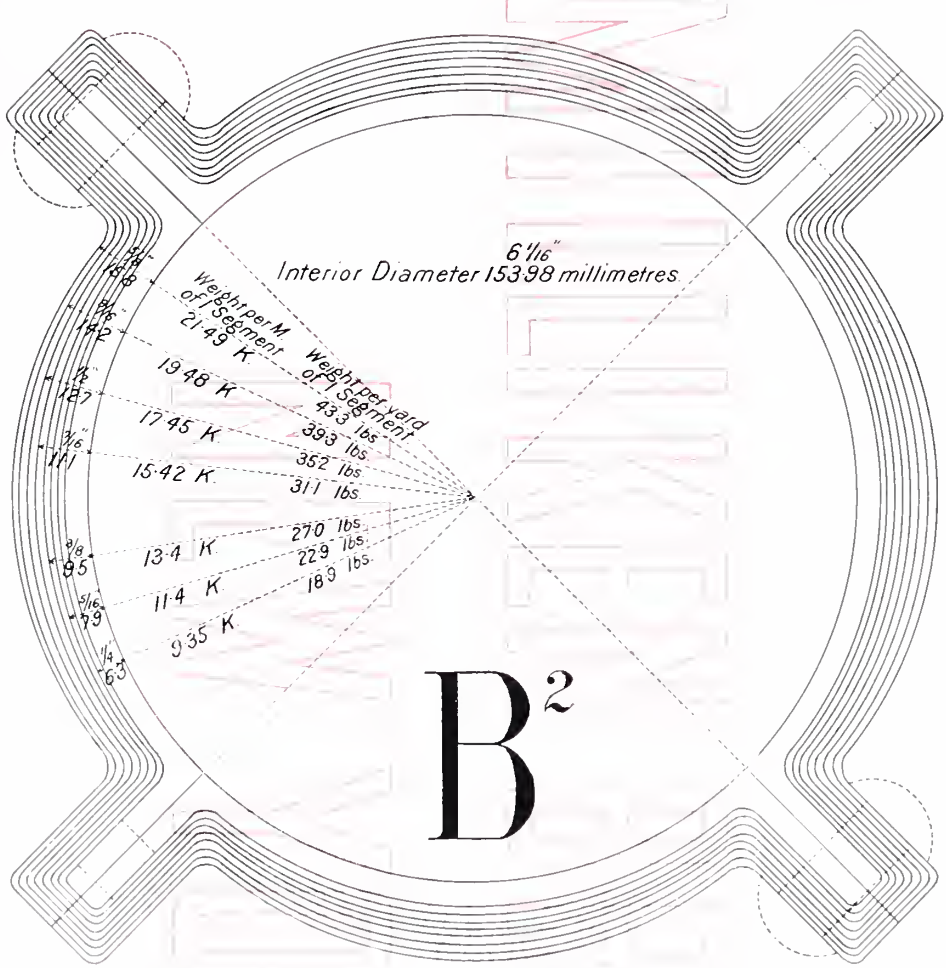


Table of dimensions for Phœnix Columns. Segments "B2."

Thickness		d		D		D1		D2		D3		One Column							
												Area.		Weight per M Kg.	Weight per ft. lbs	Least Radius of Gyration		Diameter of rivets	
mm	ins	m.m.	ins.	m.m.	ins.	m.m.	ins	m.m.	ins	m.m.	ins.	sq cm	sq ins			m.m	ins.	m.m.	ins
6.3	1/4	153.9	6 1/16	166.6	6 9/16	234.9	9 1/4	173.0	6 13/16	107.9	4 1/4	47.7	7.4	37.5	25.2	60.7	2.39	12.7	1/2
7.9	5/16	153.9	6 1/16	169.8	6 11/16	238.1	9 3/8	176.2	6 15/16	107.9	4 1/4	58.0	9.0	45.6	30.6	61.7	2.43	12.7	1/2
9.5	3/8	153.9	6 1/16	173.0	6 13/16	239.7	9 7/16	179.4	7 1/16	107.9	4 1/4	68.3	10.6	53.5	36.0	63.0	2.48	12.7	1/2
11.1	7/16	153.9	6 1/16	176.2	6 15/16	241.2	9 1/2	182.5	7 3/16	107.9	4 1/4	78.7	12.2	61.7	41.5	64.0	2.52	12.7	1/2
12.7	1/2	153.9	6 1/16	179.3	7 1/16	244.4	9 5/8	185.7	7 5/16	107.9	4 1/4	89.0	13.8	69.8	46.9	65.2	2.57	12.7	1/2
14.2	9/16	153.9	6 1/16	182.5	7 3/16	247.6	9 3/4	188.9	7 7/16	107.9	4 1/4	99.3	15.4	78.0	52.4	66.2	2.61	12.7	1/2
15.8	5/8	153.9	6 1/16	185.7	7 5/16	249.2	9 13/16	192.0	7 9/16	107.9	4 1/4	109.6	17.0	86.0	57.8	67.5	2.66	12.7	1/2

Plate No. 25.

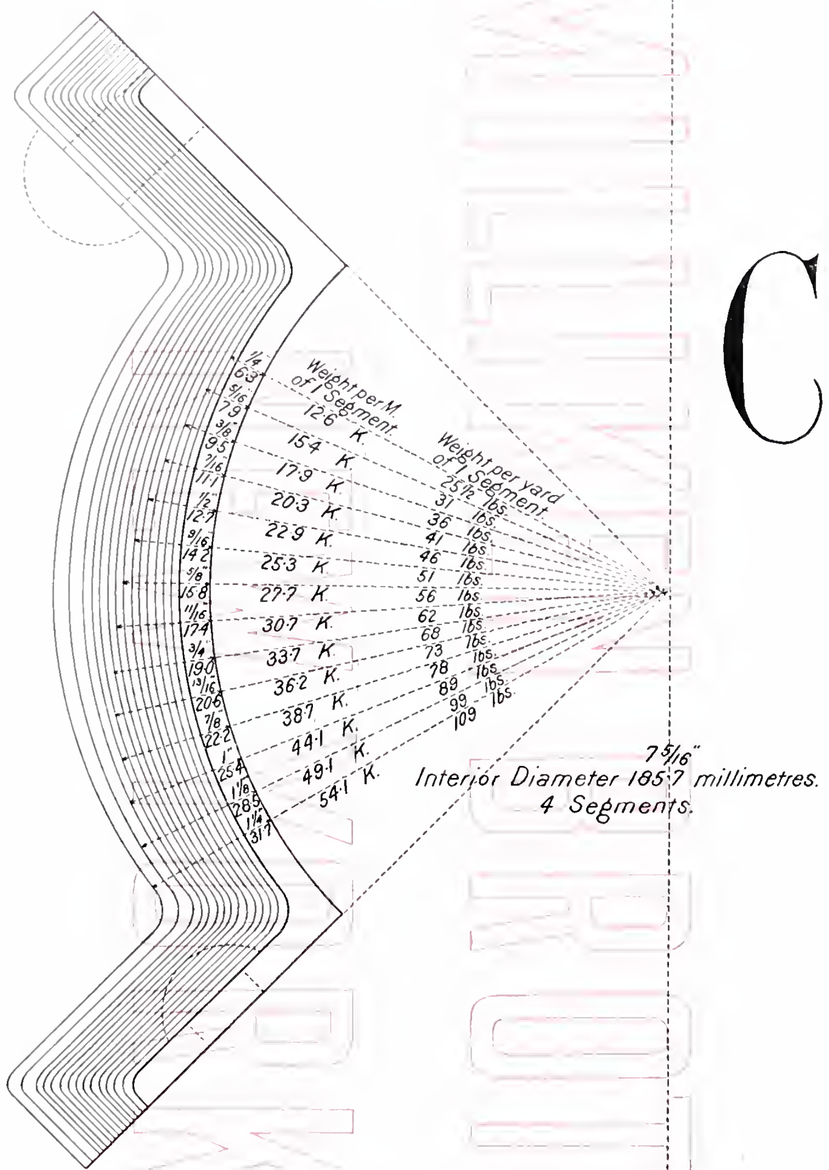


Table of dimensions for Phœnix Columns._Segments "C."

Thickness.		ins m.m.	1/4" 6·3	5/16" 7·9	3/8" 9·5	7/16" 11·1	1/2" 12·7	9/16" 14·2	5/8" 15·8	11/16" 17·4	3/4" 19·0	13/16" 20·6	7/8" 22·2	1" 25·4	1 1/8" 28·5	1 1/4" 31·7
D		ins m.m.	7 13/16" 198·4	7 15/16" 201·6	8 1/16" 204·8	8 3/16" 207·9	8 5/16" 211·1	8 7/16" 214·3	8 9/16" 217·5	8 11/16" 220·6	8 13/16" 223·8	8 15/16" 227·0	9 1/16" 230·2	9 5/16" 236·5	9 9/16" 242·9	9 13/16" 249·3
D1		ins. m.m.	11 11/16" 298·8	11 3/4" 298·4	11 13/16" 300·0	11 7/8" 301·6	11 15/16" 302·7	12" 304·9	12 1/16" 307·1	12 3/16" 309·4	12 5/16" 312·6	12 7/16" 315·9	12 1/2" 317·4	12 5/8" 320·6	12 13/16" 325·11	13" 330·1
D2		ins m.m.	8 7/16" 214·3	8 9/16" 217·4	8 11/16" 220·6	8 13/16" 223·7	8 15/16" 227·0	9 1/16" 230·2	9 3/16" 233·3	9 5/16" 236·5	9 7/16" 239·7	9 9/16" 242·9	9 11/16" 246·0	9 15/16" 252·4	10 3/16" 258·8	10 7/16" 265·1
One Column.	Area.	sq. ins sq. c.m.	10 64·5	12·1 78·1	14·1 91·0	16 103·2	18 116·1	19·9 128·4	21·9 141·3	24·3 156·8	26·6 171·6	28·6 184·5	30·6 197·4	34·8 224·5	38·8 250·3	42·7 275·5
	Weight.	lbs. per ft. Kgs. per M.	34 50·4	41·3 61·6	48·0 71·6	54·6 81·2	61·3 91·6	68 101·2	74·6 110·8	82·6 122·8	90·6 134·8	97·3 144·8	104 154·8	118·6 176·4	132 196·4	145·3 216·4
	Least Rad. of Gyration.	ins m.m.	2·84" 72·1	2·88" 73·1	2·93" 74·4	2·97" 75·4	3·01" 76·4	3·06" 77·7	3·11" 79·0	3·16" 80·3	3·20" 81·3	3·24" 82·3	3·29" 83·6	3·34" 84·8	3·48" 88·4	3·57" 90·7
Diameter of rivets.		ins m.m.	5/8" 15·8	5/8" 15·8	5/8" 15·8	5/8" 15·8	5/8" 15·8	5/8" 15·8	5/8" 15·8	3/4" 19·0	3/4" 19·0	3/4" 19·0	3/4" 19·0	3/4" 19·0	3/4" 19·0	3/4" 19·0

Plate No. 26.

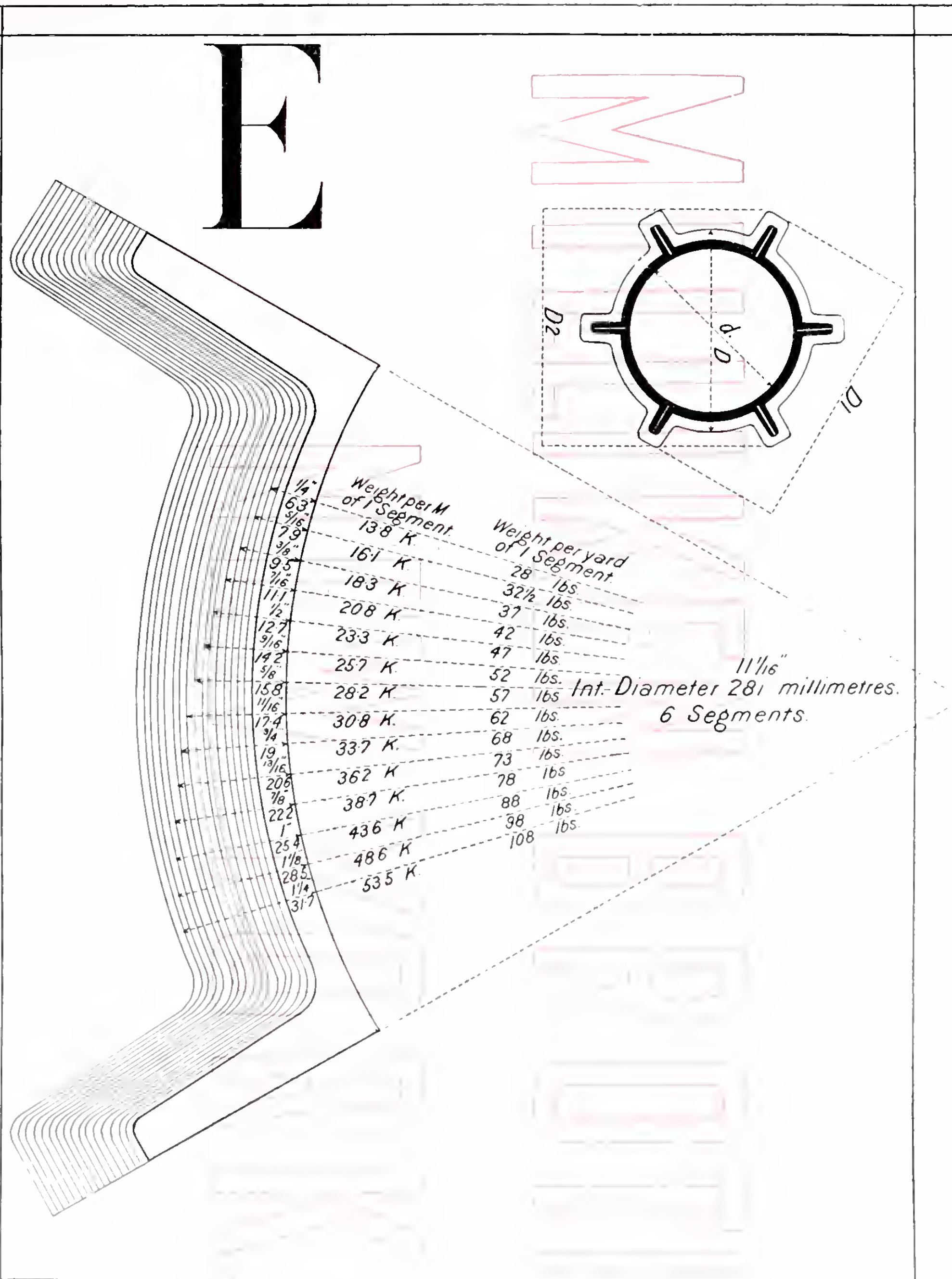


Table of dimensions for Phœnix Columns _ Segments "E".

Thickness		ins.	1/4	5/16	3/8	7/16	1/2	9/16	5/8	11/16	3/4	13/16	7/8	1	1 1/8	1 1/4
		mm.	6.3	7.9	9.5	11.1	12.7	14.2	15.8	17.4	19	20.6	22.2	25.4	28.5	31.7
D		ins	11 9/16	11 11/16	11 13/16	11 15/16	12 1/16	12 3/16	12 5/16	12 7/16	12 9/16	12 11/16	12 13/16	13 1/16	13 5/16	13 9/16
		mm	293.6	296.8	300.0	303.2	306.3	309.5	312.7	315.9	319.0	322.2	325.4	331.7	338.1	344.4
D1		ins	15 1/2	15 5/8	15 3/4	15 7/8	15 15/16	16 1/16	16 3/16	16 5/16	16 7/16	16 9/16	16 11/16	16 13/16	17 1/16	17 5/16
		mm	293.7	396.8	400.0	403.2	404.8	407.9	411.1	414.3	417.5	420.6	423.8	427	433.3	439.7
D2		ins	13 5/8	13 3/4	13 7/8	14	14 1/8	14 1/4	14 3/8	14 1/2	14 5/8	14 3/4	14 7/8	15 1/8	15 3/8	15 5/8
		mm.	346.1	349.3	352.4	355.6	358.8	361.9	365.1	368.3	371.5	374.6	377.8	384.2	390.5	396.9
One Column	Area.	sq ins.	16.5	19.1	21.7	24.7	27.6	30.6	33.5	36.4	40	43	45.9	51.7	57.6	63.5
		sq c m.	106.4	123.2	139.9	159.3	177.9	197.3	216.1	234.7	258	277.4	296.1	333.5	371.5	409.6
	Weight	lbs per ft	56	65	74	84	94	104	114	124	136	146	156	176	196	216
		Kgs per M.	83.3	96.6	110.1	125	139.8	154.8	169.7	184.8	202.4	217.2	232.2	261.9	291.6	321
	Least Rad of Gyration	ins	4.20	4.25	4.29	4.34	4.38	4.43	4.48	4.52	4.56	4.61	4.66	4.73	4.84	4.93
		mm	106.6	107.9	108.9	110.2	111.3	112.5	113.7	114.8	115.8	117.1	118.3	120.1	122.9	125.2
Diameter of rivets		ins.	5/8	5/8	5/8	5/8	5/8	5/8	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4
		mm	15.8	15.8	15.8	15.8	15.8	15.8	19	19	19	19	19	19	19	19

Plate No. 27.

G

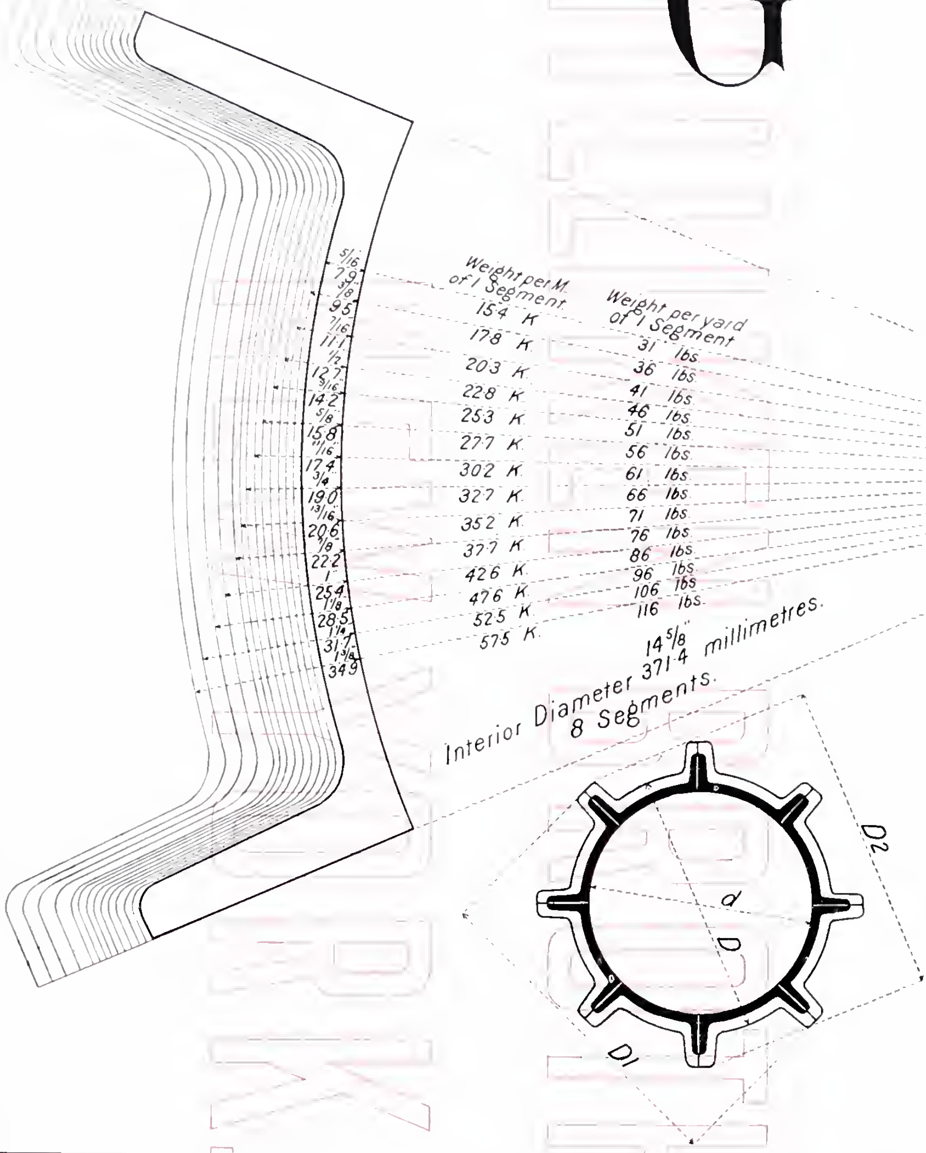
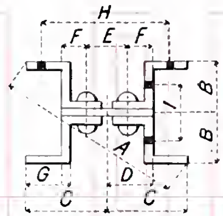


Table of dimensions for Phœnix Columns._Segments "G."

Thickness		ins	5/16	3/8	7/16	1/2	9/16	5/8	11/16	3/4	13/16	7/8	1	1 1/8	1 1/4	1 3/8
		mm.	7.9	9.5	11.1	12.7	14.2	15.8	17.4	19.0	20.6	22.2	25.4	28.5	31.7	34.9
D		ins	15 1/4	15 3/8	15 1/2	15 5/8	15 3/4	15 7/8	16	16 1/8	16 1/4	16 3/8	16 5/8	16 7/8	17 1/8	17 3/8
		mm.	387.3	390.5	393.6	396.8	400.0	403.2	406.4	409.5	412.7	415.9	422.2	428.6	434.9	441.3
D1		ins	19 3/8	19 1/2	19 5/8	19 11/16	19 3/4	19 7/8	20	20 1/8	20 1/4	20 3/8	20 5/8	20 7/8	21	21 1/4
		mm	492.1	495.2	498.4	500.0	501.6	504.8	507.9	511.1	514.3	517.5	523.8	530.2	533.4	539.7
D2		ins	18 1/8	18 1/4	18 3/8	18 1/2	18 5/8	18 3/4	18 7/8	19	19 1/8	19 1/4	19 1/2	19 3/4	20	20 1/4
		mm.	460.3	463.5	466.7	469.9	473.0	476.2	479.4	482.5	485.7	488.9	495.3	501.6	507.9	514.3
One Column	Area	sq ins	24.2	28.1	32	36	39.9	43.8	47.7	51.7	55.6	59.6	67.4	75.3	83.1	90.9
		sq cm	156.1	181.2	206.4	232.2	257.4	282.5	307.7	333.5	358.7	384.5	434.8	485.7	536.1	586.4
	Weight	lbs per ft	82.6	96	109.3	122.6	136	149.3	162.6	176	189.3	202.6	229.3	256	282.6	309.3
		Kgs per M	123.2	142.4	162.6	182.4	202.3	222.1	241.9	261.9	281.7	301.5	341.2	380.9	420.1	460.2
	Least Rad of Gyration	ins	5.54	5.59	5.64	5.68	5.73	5.77	5.82	5.88	5.91	5.95	6.04	6.13	6.27	6.32
		mm.	140.7	141.9	143.2	144.2	145.5	146.5	147.8	149.3	150.1	151.1	153.4	155.6	159.2	160.5
Diameter of rivets		ins.	5/8	5/8	5/8	5/8	5/8	5/8	3/4	3/4	3/4	3/4	3/4	3/4	3/4	3/4
		mm	15.8	15.8	15.8	15.8	15.8	15.8	19	19	19	19	19	19	19	19

Table of dimensions for 12" (304·8 m.m.) Z-Bar Columns.

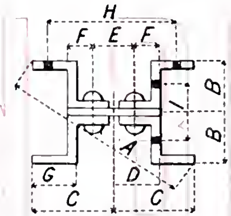


Thickness of metal		A		B		C		D		E		F		G		H		I	
m.m.	ins.	m.m.	ins.	m.m.	ins.	m.m.	ins.	m.m.	ins.	m.m.	ins.	m.m.	ins.	m.m.	ins.	m.m.	ins.	m.m.	ins.
9·5	3/8	484·1	19 1/16	157·1	6 3/16	184·2	7 1/4	104·7	4 1/8	101·6	4	54·0	2 1/8	88·9	3 1/2	279·4	11	161·9	6 3/8
12·7	1/2	490·5	19 5/16	161·9	6 3/8	184·2	7 1/4	104·7	4 1/8	101·6	4	54·0	2 1/8	92·0	3 5/8	279·4	11	165·1	6 1/2
15·8	5/8	482·6	19	161·9	6 3/8	179·3	7 1/16	104·7	4 1/8	101·6	4	54·0	2 1/8	90·4	3 9/16	279·4	11	168·3	6 5/8
19·0	3/4	476·2	18 3/4	161·9	6 3/8	174·6	6 7/8	104·7	4 1/8	101·6	4	54·0	2 1/8	88·9	3 1/2	279·4	11	171·4	6 3/4
22·2	7/8	482·6	19	166·6	6 9/16	174·6	6 7/8	104·7	4 1/8	101·6	4	54·0	2 1/8	92·0	3 5/8	279·4	11	174·6	6 7/8

6" 6 1/8"
Section: 4 Z-Bars 152·4–155·5 m.m. deep.
8"
1 Web Plate 203·2 m.m. x thickness of Z-Bars.

Plate No. 29.

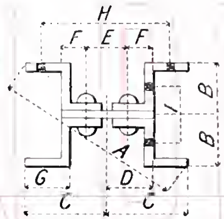
Table of dimensions for 10" (254 m.m.) Z-Bar Columns.



Thickness of metal		A		B		E		D		E		F		G		H		I	
m.m.	ins.	m.m.	ins.	m.m.	ins.	m.m.	ins.	m.m.	ins.	m.m.	ins.	m.m.	ins.	m.m.	ins.	m.m.	ins.	m.m.	ins.
7·9	5/16	423·9	16 11/16	130·9	5 5/32	166·6	6 9/16	92·0	3 5/8	88·9	3 1/2	47·6	1 7/8	82·5	3 1/4	254·0	10	134·9	5 5/16
11·1	7/16	430·2	16 15/16	135·7	5 11/32	166·6	6 9/16	92·0	3 5/8	88·9	3 1/2	47·6	1 7/8	85·7	3 3/8	254·0	10	138·1	5 7/16
14·2	9/16	422·2	16 5/8	135·7	5 11/32	161·9	6 3/8	92·0	3 5/8	88·9	3 1/2	47·6	1 7/8	84·1	3 5/16	254·0	10	141·2	5 9/16
17·4	11/16	415·9	16 3/8	135·7	5 11/32	157·1	6 3/16	92·0	3 5/8	88·9	3 1/2	47·6	1 7/8	82·5	3 1/4	254·0	10	144·4	5 11/16
20·6	13/16	419·1	16 1/2	140·5	5 17/32	155·6	6 1/8	92·0	3 5/8	88·9	3 1/2	47·6	1 7/8	85·7	3 3/8	254·0	10	147·6	5 13/16

5"   5 1/8"
Section: 4 Z-Bars 126·99-130·17 m.m. deep.
7"
1 Web Plate 177·79 m.m. x thickness of Z-Bars.

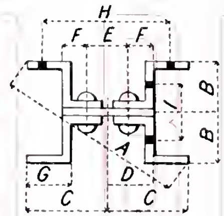
Table of dimensions for 8" (203·2 m.m.) Z-Bar Columns.



Thickness of metal		A		B		C		D		E		F		G		H		I	
m.m.	ins	m.m.	ins.	m.m.	ins	m.m.	ins	m.m.	ins.	m.m.	ins	m.m.	ins.	m.m.	ins	m.m.	ins	m.m.	ins
6·3	1/4	388·9	15 5/16	104·7	4 1/8	163·5	6 7/16	92·0	3 5/8	88·9	3 1/2	47·6	1 7/8	77·7	3 1/16	254·0	10	107·9	4 1/4
9·5	3/8	393·7	15 1/2	109·5	4 5/16	163·5	6 7/16	92·0	3 5/8	88·9	3 1/2	47·6	1 7/8	80·9	3 3/16	254·0	10	111·1	4 3/8
12·7	1/2	385·7	15 3/16	109·5	4 5/16	158·7	6 1/4	92·0	3 5/8	88·9	3 1/2	47·6	1 7/8	79·3	3 1/8	254·0	10	114·3	4 1/2
15·8	5/8	377·8	14 7/8	109·5	4 5/16	153·8	6 1/16	92·0	3 5/8	88·9	3 1/2	47·6	1 7/8	77·7	3 1/16	254·0	10	117·4	4 5/8
19·0	3/4	384·1	15 1/8	114·3	4 1/2	153·8	6 1/16	92·0	3 5/8	88·9	3 1/2	47·6	1 7/8	80·9	3 3/16	254·0	10	120·6	4 3/4

Section: 4 Z-Bars 101·59 (4") – 104·77 (4 1/8") m.m. deep
1 Web Plate 165 (6 1/2") m.m. x thickness of Z-Bars.

Table of dimensions for 6" (152·39 m.m.) Z-Bar Columns.



Thickness of metal		A		B		C		D		E		F		G		H		I	
m.m	ins	m.m	ins	m.m.	ins.	m.m.	ins.	m.m.	ins.	m.m.	ins.	m.m.	ins.	m.m.	ins.	m.m.	ins.	m.m.	ins.
6·3	1/4	323·8	12 3/4	79·3	3 1/8	141·2	5 9/16	79·4	3 1/8	76·2	3	41·2	1 5/8	68·2	2 11/16	215·9	8 1/2	82·5	3 1/4
7·9	5/16	327·0	12 7/8	81·7	3 7/32	141·2	5 9/16	79·4	3 1/8	76·2	3	41·2	1 5/8	69·8	2 3/4	215·9	8 1/2	84·1	3 5/16
9·5	3/8	320·7	12 5/8	80·9	3 3/16	138·1	5 7/16	79·4	3 1/8	76·2	3	41·2	1 5/8	68·2	2 11/16	215·9	8 1/2	85·7	3 3/8
11·1	7/16	322·3	12 11/16	83·3	3 9/32	138·1	5 7/16	79·4	3 1/8	76·2	3	41·2	1 5/8	69·8	2 3/4	215·9	8 1/2	87·3	3 7/16
12·7	1/2	315·9	12 7/16	82·5	3 1/4	134·9	5 5/16	79·4	3 1/8	76·2	3	41·2	1 5/8	68·2	2 11/16	215·9	8 1/2	88·9	3 1/2
14·2	9/16	319·1	12 9/16	84·9	3 11/32	134·9	5 5/16	79·4	3 1/8	76·2	3	41·2	1 5/8	69·8	2 3/4	215·9	8 1/2	90·4	3 9/16

Section: 4 Z-Bars 76·2 (3") – 77·7 (3 1/16") m.m. deep.
1 Web Plate 146 (5 3/4") m.m. x thickness of Z-Bars.

EXPLANATION OF PLATES OF ROLLED SECTIONS.

It will be noticed that on all of these plates the dimensions are given both in inches and in millimetres, and the weights are given in pounds per lineal foot and in kilograms per metre.

Plate No 1 and Plate No. 2 give the dimensions of the various bars and plates that we are able to furnish; that is rounds, squares, half rounds and rectangular plates.

The following plates, commencing with Plate No. 3 and extending to Plate No. 31, give the dimensions of the various classes of structural material. The sections as shown on these plates have been calculated for the lightest weights to which each shape or pattern can be rolled. It is possible to roll heavier sections as shown on Plates Nos. 6, 9, 11, 13, 16, 18, 20, 22, 23, 24, 25, 26 and 27. This is accomplished by means of separating or spreading the rolls, the method being clearly illustrated on Plate No 21.

It is well to note that the extra heavy sections are not always kept in stock and are therefore obtained only by special rolling which requires an order of a sufficient weight to warrant the changing of the rolls. It is therefore advantageous for parties ordering to confine themselves as far as possible to the minimum weights, if quick delivery is required.

In ordering rolled sections, it is necessary that the order be clearly written out to avoid any misunderstanding. The usual practice, as adopted in this country, and which we would like our customers to be

careful to follow to avoid any mistakes is to specify, first, the number of pieces wanted; then the name of the piece required, and following this the dimension and the weight, and lastly the length of each bar.

In describing rounds, the diameter is given.

In describing squares, one side of the square is given.

In describing half rounds, the diameter is given.

In describing plates, the width and thickness are given.

In describing beams, deck beams and channels, the depth is given.

In describing angles, the length of each leg is given.

In describing Tees,. the depth of stem and the width of the flange are given.

It is very important in describing Tees with unequal legs to introduce a sketch on the order, to give the dimension of the vertical leg and of the horizontal flange so no mistake can be made.

In describing Bulb angles, the depth is given.

In describing Zee bars, the depth is given and the length of each horizontal flange.

Phœnix and Zee bar columns are always ordered by drawings; it being impossible to order them by any general description on account of the riveted connections, that is the cap and base plates. These with any intermediate connections should be shown on drawings to avoid misunderstanding.

To clearly illustrate what we have mentioned above relative to ordering raw material, we give the following illustration of how an order should read, specifying the different classes of material, as ordered in feet, inches and pounds.

Number of Pieces.	Description.	Dimensions and Weight.	Length.
6	Bars, round	1½ in. diameter	10 ft. 6 in.
5	Bars, square	2 " square	8 " 6 "
3	Bars, half round	1⅜ " diameter	15 " 0 "
10	Plates	25 " x ⅜ in.	20 " 10 "
4	Beams	15 " 80 lbs.	26 " 8 "
8	Deck Beams	10 " 35 lbs.	14 " 10 "
5	Channels	9 " 25 lbs.	21 " 0 "
12	Angles	6 " x 6 in., 33.1 lbs.	27 " 8 "
12	Angles	5 " x 3 " 8.2 "	16 " 4 "
4	Tees 	4 " x 4 " 13.7 "	8 " 1 "
4	Tees	4 " x 3 " 10.2 "	15 " 2 "
4	Tees 	3 " x 4 " 10.6 "	10 " 1 "
6	Bulb Angles	8 " 19.23 lbs.	17 " 8 "
4	Zee Bars	5 " x 3¼ in. x 3¼ in., 11.6 lbs.	13 " 2 "

All weights are given in pounds per foot.

TABLES

GIVING STRENGTH OF STEEL AND IRON WORK

MANUFACTURED BY

MILLIKEN BROTHERS,

11 BROADWAY,

NEW YORK CITY, U. S. A.

Table No. 1.

Safe Loads in Kilograms and Pounds uniformly distributed for steel I-Beams standard sections.

Length of Span in M	Length of Span in ft	24" Depth of Beam 609.58 m.m.									
		Weight per ft. 100 lbs.	Weight per M. 148.82 Kgs.	Weight per ft. 95 lbs.	Weight per M. 141.38 Kgs.	Weight per ft. 90 lbs.	Weight per M. 133.93 Kgs.	Weight per ft. 85 lbs.	Weight per M. 126.49 Kgs.	Weight per ft. 80 lbs.	Weight per M. 119.05 Kgs.
		lbs	Kgs	lbs	Kgs	lbs	Kgs	lbs	Kgs	lbs	Kgs
4	13.123	161226	73131	156432	70957	151662	68793	146885	66626	141422	64148
4.5	14.764	143313	65006	139050	63072	134812	61150	130566	59224	125707	57020
5	16.404	128981	58505	125145	56765	121331	55035	117508	53301	113137	51318
5.5	18.044	117255	53186	113767	51604	110299	50031	106825	48455	102852	46653
6	19.685	107484	48754	104287	47304	101108	45862	97922	44417	94280	42765
6.5	21.325	99214	45003	96265	43665	93330	42334	90389	41000	87027	39475
7	22.966	92128	41789	89390	40547	86663	39310	83934	38072	80812	36656
7.5	24.606	85986	39003	83429	37843	80885	36689	78337	35533	75424	34212
8	26.247	80613	36565	78216	35478	75832	34396	73442	33313	70711	32074
8.5	27.887	75869	34414	73615	33391	71370	32373	69121	31353	66550	30187
9	29.528	71656	32503	69525	31536	67406	30575	65283	29612	62853	28510
9.5	31.168	67884	30792	65867	29877	63856	28965	61843	28052	59544	27009
10	32.808	64490	29252	62572	28382	60665	27517	58754	26650	56568	25659
		C1-2115800	C 292524	C1-2052900	C 283827	C1-1990300	C 275173	C1-1927600	C 266504	C1-1855900	C 256591

Length of Span in M	Length of Span in ft	20" Depth of Beam 507.99 m.m.															
		Weight per ft. 100 lbs.	Weight per M. 148.82 Kgs.	Weight per ft. 95 lbs.	Weight per M. 141.38 Kgs.	Weight per ft. 90 lbs.	Weight per M. 133.93 Kgs.	Weight per ft. 85 lbs.	Weight per M. 126.49 Kgs.	Weight per ft. 80 lbs.	Weight per M. 119.05 Kgs.	Weight per ft. 75 lbs.	Weight per M. 111.61 Kgs.	Weight per ft. 70 lbs.	Weight per M. 104.17 Kgs.	Weight per ft. 65 lbs.	Weight per M. 96.73 Kgs.
		lbs	Kgs	lbs	Kgs	lbs	Kgs	lbs	Kgs	lbs	Kgs	lbs	Kgs	lbs	Kgs	lbs	Kgs
4	13.123	134579	61044	130600	59239	126615	57432	122629	55624	119202	54069	103137	46782	99152	44975	95068	43122
4.5	14.764	119625	54261	116086	52656	112546	51050	109004	49444	105974	48060	91676	41584	88132	39976	84503	38330
5	16.404	107662	48835	104479	47391	101291	45945	98103	44499	95361	43255	82510	37426	79322	35980	76054	34498
5.5	18.044	97873	44395	94982	43083	92082	41768	89185	40454	86690	39322	75007	34023	72111	32709	69141	31362
6	19.685	89719	40696	87067	39493	84410	38288	81754	37083	79467	36046	68757	31188	66101	29983	63378	28748
6.5	21.325	82816	37565	80369	36455	77916	35342	75464	34230	73354	33273	63468	28789	61017	27677	58501	26536
7	22.966	76901	34882	74629	33851	72351	32818	70073	31785	68114	30896	58936	26733	56659	25700	54324	24641
7.5	24.606	71773	32556	69652	31594	67527	30630	65402	29666	63572	28836	55005	24950	52980	23986	50702	22998
8	26.247	67289	30522	65300	29619	63307	28716	61314	27812	59601	27034	51568	23391	49576	22487	47534	21561
8.5	27.887	63329	28726	61458	27877	59582	27026	57708	26176	56094	25444	48535	22015	46658	21164	44735	20292
9	29.528	59812	27130	58043	26328	56273	25525	54502	24722	52987	24030	45838	20792	44066	19988	42251	19165
9.5	31.168	56663	25702	54990	24943	53312	24182	51632	23420	50188	22765	43424	19697	41746	18936	40027	18156
10	32.808	53831	24417	52239	23695	50645	22972	49051	22249	47681	21627	41255	18713	39661	17990	38027	17248
		C1-1766100	C 244175	C1-1713900	C 236958	C1-1661600	C 229728	C1-1609300	C 222497	C1-1564300	C 216275	C1-1353500	C 187130	C1-1301200	C 179900	C1-1247600	C 172489

C1 = Coefficient of strength for maximum fiber stress of 16000 lbs. per sq in.

C = Coefficient of strength for maximum fiber stress of 1125 kgs. per sq c.m.

For a single load concentrated at the centre of the beam take one half (½) the load given in the table.

Table No. 2.

Safe Loads in Kilograms and Pounds uniformly distributed for steel I-Beams standard sections.

Depth of Beam 15" 38099 m.m.

Length of Span in M.	Length of Span in ft.	Weight per ft. 100 lbs.	Weight per M. 148·82 Kgs.	Weight per ft. 95 lbs.	Weight per M. 141·38 Kgs.	Weight per ft. 90 lbs.	Weight per M. 133·93 Kgs.	Weight per ft. 85 lbs.	Weight per M. 126·49 Kgs.	Weight per ft. 80 lbs.	Weight per M. 119·05 Kgs.	Weight per ft. 75 lbs.	Weight per M. 111·61 Kgs.
		lbs	Kgs.	lbs	Kgs	lbs	Kgs	lbs	Kgs	lbs	Kgs	lbs	Kgs
4	13123	97589	44266	94602	42911	91614	41556	88621	40198	86205	39102	74904	33976
4·5	14·764	86747	39348	84093	38144	81434	36938	78775	35732	76628	34758	66584	30202
5	16·404	78072	35413	75682	34328	73293	33245	70896	32158	68964	31282	59924	27181
5·5	18·044	70973	32193	68801	31208	66628	30222	64450	29234	62694	28438	54476	24710
6	19685	65060	29511	63069	28608	61077	27704	59081	26799	57470	26068	49937	22651
6·5	21·325	60054	27240	58217	26407	56379	25573	54536	24737	53050	24063	46094	20908
7	22966	55766	25295	54061	24521	52350	23746	50640	22970	49260	22344	42802	19415
7·5	24606	52046	23608	50455	22886	48861	22163	47265	21439	45974	20854	39947	18120
8	26·247	48795	22133	47302	21456	45807	20778	44310	20099	43102	19551	37452	16988
8·5	27887	45924	20831	44517	20193	43113	19556	41702	18916	40567	18401	35249	15989
9	29528	43373	19674	42046	19072	40717	18469	39387	17866	38314	17379	33294	15101
9·5	31168	41089	18638	39822	18068	38574	17497	37313	16925	36296	16464	31526	14305
10	32808	39035	17706	37840	17164	36545	16622	35448	16079	34482	15641	29962	13590
		C1-1280700	C 177064	C1-1241500	C 171646	C1-1202300	C 166226	C1-1163000	C 160793	C1-1131300	C 156410	C1-983000	C 135906

Length of Span in M.	Length of Span in ft.	Weight per ft. 70 lbs.	Weight per M. 104·17 Kgs.	Weight per ft. 65 lbs.	Weight per M. 96·73 Kgs.	Weight per ft. 60 lbs.	Weight per M. 89·29 Kgs.	Weight per ft. 55 lbs.	Weight per M. 81·85 Kgs.	Weight per ft. 50 lbs.	Weight per M. 74·41 Kgs.	Weight per ft. 45 lbs.	Weight per M. 66·96 Kgs.	Weight per ft. 42 lbs.	Weight per M. 62·50 Kgs.
		lbs	Kgs	lbs	Kgs.	lbs	Kgs	lbs	Kgs	lbs	Kgs	lbs	Kgs	lbs	Kgs
4	13123	71919	32622	68930	31267	65997	29936	55382	25121	52388	23763	49392	22404	47877	21717
4·5	14·764	63924	28996	61271	27792	58662	26609	49230	22330	46566	21122	43902	19914	42555	19303
5	16·404	57533	26097	55144	25013	52798	23949	44306	20097	41910	19010	39513	17923	38300	17373
5·5	18·044	52302	23724	50131	22739	47996	21771	40278	18270	38098	17281	35920	16293	34817	15793
6	19685	47946	21748	45952	20844	43997	19957	36920	16747	34925	15842	32928	14936	31916	14477
6·5	21·325	44257	20075	42419	19241	40613	18422	34081	15459	32238	14623	30395	13787	29462	13364
7	22966	41095	18641	39389	17867	37712	17106	31647	14355	29936	13579	28223	12802	27357	12409
7·5	24606	38356	17398	36762	16675	34196	15965	29537	13398	27939	12673	26343	11949	25534	11582
8	26·247	35959	16311	34464	15633	32998	14968	27690	12560	26194	11881	24696	11202	23938	10858
8·5	27887	33843	15351	32336	14713	31056	14087	26060	11821	24552	11182	23283	10543	22529	10219
9	29528	31962	14498	30635	13896	29331	13305	24615	11165	23233	10561	21951	9957	21277	9652
9·5	31168	30280	13735	29024	13165	27787	12604	23318	10577	22057	10005	20796	9433	20156	9143
10	32808	28766	13048	27571	12506	26399	11974	22152	10048	20955	9505	19754	8961	19150	8686
		C1-943800	C 130487	C1-904600	C 125067	C1-866100	C 119744	C1-726800	C 100485	C1-687500	C 95052	C1-648200	C 89618	C1-628300	C 86867

C1 = Coefficient of strength for maximum fiber stress of 16000 lbs. per sq in.

C = Coefficient of strength for maximum fiber stress of 1125 kgs. per sq c m

For a single load concentrated at the centre of the beam take one half (½) the load given in the table.

Table No. 3.

Safe Loads in Kilograms and Pounds uniformly distributed for steel I-Beams standard sections.

Length of Span in M.	Length of Span in ft.	18" Depth of Beam 457·19 m.m.							
		Weight per ft. 70 lbs.	Weight per M. 104·17 Kgs.	Weight per ft. 65 lbs.	Weight per M. 96·73 Kgs.	Weight per ft. 60 lbs.	Weight per M. 89·29 Kgs.	Weight per ft. 55 lbs.	Weight per M. 81·85 Kgs.
		lbs	Kgs	lbs	Kgs	lbs	Kgs	lbs	Kgs
4	13123	83422	37740	79615	36113	76026	34485	71856	32594
4·5	14764	73956	33546	70768	32100	67575	30652	63872	28972
5	16404	66550	30192	63691	28890	60810	27583	57485	26075
5·5	18044	60505	27447	57900	26263	55292	25080	52258	23704
6	19685	55468	25160	53076	24075	50681	22989	47904	21729
6·5	21·325	51202	23225	48994	22223	46784	21221	44218	20057
7	22966	47544	21566	45493	20636	43441	19705	41061	18625
7·5	24606	44373	20128	42460	19260	40545	18391	38373	17383
8	26247	41601	18870	39806	18056	38011	17242	35928	16297
8·5	27887	39153	17760	37462	16993	35776	16228	33814	15338
9	29·528	36977	16773	35384	16050	33787	15326	31936	14486
9·5	31168	35031	15890	33521	15205	32008	14519	30254	13723
10	32808	33280	15096	31845	14445	30408	13793	28741	13037
		CI-1091900	C 150962	CI-1044800	C 144451	CI-997700	C 137939	CI-943000	C 130376

Length of Span in M.	Length of Span in ft.	12" Depth of Beam 304·79 m.m.											
		Weight per ft. 55 lbs.	Weight per M. 81·85 Kgs.	Weight per ft. 50 lbs.	Weight per M. 74·41 Kgs.	Weight per ft. 45 lbs.	Weight per M. 66·96 Kgs.	Weight per ft. 40 lbs.	Weight per M. 59·52 Kgs.	Weight per ft. 35 lbs.	Weight per M. 52·08 Kgs.	Weight per ft. 31·5 lbs.	Weight per M. 46·87 Kgs.
		lbs	Kgs	lbs	Kgs	lbs	Kgs	lbs	Kgs	lbs	Kgs	lbs	Kgs
4	13123	43479	19722	41087	18637	38702	17555	36431	16525	30922	14026	29237	13262
4·5	14764	38646	17530	36521	16566	34400	15604	32384	14689	27487	12468	25988	11788
5	16404	34784	15778	32868	14909	30961	14044	29145	13220	24738	11221	23387	10609
5·5	18044	31620	14343	29879	13553	28146	12767	26495	12018	22488	10201	21263	9645
6	19685	28986	13148	27390	12424	25800	11703	24286	11016	20615	9351	19491	8841
6·5	21·325	26754	12136	25282	11468	23816	10803	22418	10169	19028	8631	17992	8161
7	22966	24844	11269	23477	10649	22114	10031	20818	9443	17670	8015	16706	7578
7·5	24606	23188	10518	21911	9939	20639	9362	19429	8813	16490	7480	15593	7073
8	26247	21739	9861	20542	9318	19350	8777	18214	8262	15461	7013	14618	6631
8·5	27887	20461	9281	19334	8770	18212	8261	17143	7776	14550	6600	13759	6241
9	29·528	19323	8765	18260	8283	17200	7802	16190	7344	13744	6234	12994	5894
9·5	31168	18307	8304	17300	7847	16294	7391	15337	6957	13018	5905	12310	5584
10	32808	17390	7888	16433	7454	15481	7022	14572	6610	12368	5610	11693	5304
		CI-570600	C 78889	CI-539200	C 74548	CI-507900	C 70220	CI-478100	C 66100	CI-405800	C 56104	CI-383700	C 53049

Length of Span in M.	Length of Span in ft.	10" Depth of Beam 253·99 m.m.							
		Weight per ft. 40 lbs.	Weight per M. 59·52 Kgs.	Weight per ft. 35 lbs.	Weight per M. 52·08 Kgs.	Weight per ft. 30 lbs.	Weight per M. 44·64 Kgs.	Weight per ft. 25 lbs.	Weight per M. 37·20 Kgs.
		lbs.	Kgs.	lbs.	Kgs.	lbs.	Kgs.	lbs.	Kgs.
4	13123	25794	11700	23803	10798	21816	9896	19850	9004
4·5	14764	22928	10400	21160	9598	19392	8796	17643	8003
5	16404	20635	9360	19043	8638	17451	7916	15880	7203
5·5	18044	18759	8509	17310	7852	15864	7196	14436	6548
6	19685	17196	7800	15869	7198	14543	6596	13232	6002
6·5	21·325	15873	7200	14644	6643	13424	6089	12213	5540
7	22966	14739	6686	13602	6170	12467	5655	11342	5145
7·5	24606	13756	6240	12694	5758	11636	5278	10587	4802
8	26247	12897	5850	11903	5399	10908	4948	9925	4502
8·5	27887	12138	5506	11201	5081	10267	4657	9341	4237
9	29·528	11464	5200	10580	4799	9696	4398	8823	4002
9·5	31168	10860	4926	10022	4546	9184	4166	8357	3791
10	32808	10317	4680	9521	4319	8726	3958	7941	3601
		CI-338500	C 46800	CI-312400	C 43191	CI-286300	C 39583	CI-260500	C 36016

CI = Coefficient of strength for maximum fiber stress of 16000 lbs. per sq. in.

C = Coefficient of strength for maximum fiber stress of 1125 kgs. per sq. c.m.

For a single load concentrated at the centre of the beam take one half (½) the load given in the table.

Table No. 4.

Safe Loads in Kilograms and Pounds uniformly distributed for steel I-Beams standard sections.

Length of Span in M.	Length of Span in ft.	9" Depth of Beam 228·59 m.m. Weight per ft. 35 lbs.	Weight per M. 52·08 Kgs.	Weight per ft. 30 lbs.	Weight per M. 44·64 Kgs.	Weight per ft. 25 lbs.	Weight per M. 37·20 Kgs.	Weight per ft. 21 lbs.	Weight per M. 31·25 Kgs.
		lbs	Kgs	lbs	Kgs	lbs.	Kgs	lbs.	Kgs
4	13·123	20192	9159	18400	8347	16600	7531	15338	6958
4·5	14·764	17950	8142	16354	7418	14758	6694	13633	6184
5	16·404	16153	7327	14722	6678	13282	6025	12250	5566
5·5	18·044	14685	6661	13384	6071	12074	5477	11155	5060
6	19·685	13461	6106	12268	5565	11069	5021	10224	4638
6·5	21·325	12425	5636	11322	5136	10216	4634	9437	4281
7	22·966	11539	5234	10513	4769	9486	4303	8765	3976
7·5	24·606	10769	4885	9872	4451	8853	4016	8179	3710
8	26·247	10096	4579	9200	4173	8300	3766	7669	3479
8·5	27·887	9502	4310	8660	3928	7813	3544	7217	3274
9	29·528	8975	4071	8177	3709	7379	3347	6815	3092
		C1-265000	C 36638	C1-241500	C 33389	C1-217900	C 30126	C1-201300	C 27831

Length of Span in M.	Length of Span in ft.	8" Depth of Beam 203·15 m.m. Weight per ft. 25·5 lbs.	Weight per M. 37·95 Kgs.	Weight per ft. 23 lbs.	Weight per M. 34·22 Kgs.	Weight per ft. 20·5 lbs.	Weight per M. 30·50 Kgs.	Weight per ft. 18 lbs.	Weight per M. 26·78 Kgs.	7" Depth of Beam 177·79 m.m. Weight per ft. 20 lbs.	Weight per M. 29·76 Kgs.	Weight per ft. 17·5 lbs.	Weight per M. 26·04 Kgs.	Weight per ft. 15 lbs.	Weight per M. 22·32 Kgs.
		lbs	Kgs	lbs	Kgs	lbs	Kgs.	lbs	Kgs	lbs	Kgs	lbs	Kgs.	lbs	Kgs
1·5	4921	37081	16820	33264	15854	31070	14894	30824	13982	26132	11854	24272	11005	22434	10176
2	6561	27812	12616	26212	11890	24626	11171	23117	10486	19598	8890	18196	8254	16825	7632
2·5	8202	22248	10092	20970	9512	19700	8936	18494	8389	15678	7112	14555	6602	13460	6105
3	9842	18540	8410	17475	7927	16417	7447	15411	6991	13066	5927	12131	5503	11217	5088
3·5	11483	15895	7210	14978	6794	14074	6384	13210	5992	11199	5080	10396	4716	9612	4360
4	13·123	13906	6308	13106	5945	12312	5585	11558	5243	9799	4445	9098	4127	8412	3816
4·5	14·764	12360	5607	11649	5284	10945	4965	10275	4661	8710	3951	8086	3668	7478	3392
5	16·404	11124	5046	10485	4756	9850	4468	9245	4194	7839	3556	7277	3301	6730	3052
5·5	18·044	10111	4587	9530	4323	8955	4062	8405	3813	7126	3233	6616	3001	6117	2775
6	19685	9270	4205	8736	3963	8207	3723	7704	3495	6531	2963	6064	2751	5608	2544
6·5	21·325	8553	3880	8064	3658	7576	3437	7111	3226	6000	2735	5597	2539	5175	2348
		C1-182500	C 25232	C1-172000	C 23780	C1-161600	C 22342	C1-151700	C 20973	C1-128600	C 17780	C1-119400	C 16508	C1-110400	C 15263

C1 = Coefficient of strength for maximum fiber stress of 16000 lbs. per sq. in.
C = Coefficient of strength for maximum fiber stress of 1125 kgs. per sq. c.m.
For a single load concentrated at the centre of the beam take one half ($\frac{1}{2}$) the load given in the table.

Table No. 5.

Safe Loads in Kilograms and Pounds uniformly distributed for steel I-Beams standard sections.

Length of Span in M.	Length of Span in ft.	Depth of Beam 152·39 m.m. (6")						Depth of Beam 126·99 m.m. (5")					
		Weight per ft. 17·25 lbs.	Weight per M. 25·67 Kgs.	Weight per ft. 14·75 lbs.	Weight per M. 21·95 Kgs.	Weight per ft. 12·25 lbs.	Weight per M. 18·23 Kgs.	Weight per ft. 14·75 lbs.	Weight per M. 21·95 Kgs.	Weight per ft. 12·25 lbs.	Weight per M. 18·23 Kgs.	Weight per ft. 9·75 lbs.	Weight per M. 14·51 Kgs.
		lbs	Kgs	lbs.	Kgs	lbs	Kgs	lbs.	Kgs	lbs	Kgs.	lbs	Kgs
1·5	4·921	18920	8582	17332	7862	15747	7143	13126	5954	11808	5356	10485	4756
2	6·561	14189	6436	12998	5896	11810	5357	9843	4465	8854	4016	7864	3567
2·5	8·202	11349	5148	10401	4718	9449	4286	7875	3572	7081	3212	6296	2856
3	9·842	9460	4291	8666	3931	7873	3572	6563	2977	5904	2678	5242	2378
3·5	11·483	8008	3678	7429	3370	6757	3065	5626	2552	5057	2294	4493	2038
4	13·123	7094	3218	6499	2948	5905	2679	4921	2233	4427	2008	3932	1783
4·5	14·764	6307	2861	5777	2621	5249	2381	4375	1985	3935	1785	3495	1585
5	16·404	5674	2574	5200	2359	4724	2143	3937	1786	3540	1606	3148	1427
5·5	18·044	5158	2340	4726	2144	4594	1948	3580	1624	3218	1460	2861	1298
6	19·685	4730	2145	4333	1965	3937	1786	3281	1488	2952	1339	2621	1189
6·5	21·325	4365	1980	3999	1814	3633	1648	2994	1358	2722	1235	2418	1097
		CI-93100	C 12872	CI-85300	C 11793	CI-77500	C 10715	CI-64600	C 8931	CI-58100	C 8033	CI-51600	C 7134

Length of Span in M.	Length of Span in ft.	Depth of Beam 101·59 m.m. (4")						Depth of Beam 76·19 m.m. (3")					
		Weight per ft. 10·5 lbs.	Weight per M. 15·62 Kgs.	Weight per ft. 9·5 lbs.	Weight per M. 14·13 Kgs.	Weight per ft. 8·5 lbs.	Weight per M. 12·64 Kgs.	Weight per ft. 7·5 lbs.	Weight per M. 11·16 Kgs.	Weight per ft. 7·5 lbs.	Weight per M. 11·16 Kgs.	Weight per ft. 6·5 lbs.	Weight per M. 9·67 Kgs.	Weight per ft. 5·5 lbs.	Weight per M. 8·18 Kgs.
		lbs.	Kgs.	lbs.	Kgs	lbs.	Kgs.	lbs.	Kgs.	lbs.	Kgs.	lbs.	Kgs	lbs.	Kgs.
1·5	4·921	7742	3512	7315	3318	6887	3124	6459	2930	4205	1908	3880	1767	3576	1622
2	6·561	5805	2633	5485	2486	5167	2344	4845	2198	3155	1431	2910	1320	2680	1216
2·5	8·202	4643	2106	4387	1997	4131	1874	3875	1758	2522	1144	2325	1056	2165	972
3	9·842	3871	1756	3657	1659	3443	1562	3229	1465	2103	954	1940	887	1788	811
3·5	11·483	3315	1504	3135	1422	2949	1336	2769	1256	1803	816	1662	754	1508	694
4	13·123	2902	1317	2747	1244	2583	1172	2422	1099	1577	715	1455	660	1340	608
4·5	14·764	2580	1171	2435	1106	2295	1041	2153	977	1402	636	1294	587	1190	547
5	16·404	2321	1053	2193	995	2065	937	1937	879	1261	572	1164	522	1082	486
5·5	18·044	2109	957	1995	905	1876	851	1761	799	1146	520	1058	480	974	442
6	19·685	1935	878	1828	829	1721	781	1614	732	1051	477	970	440	894	405
6·5	21·325	1785	810	1686	765	1589	721	1490	676	970	440	895	406	824	374
		CI-38100	C 5267	CI-36000	C 4977	CI-33900	C 4687	CI-31800	C 4396	CI-20700	C 2862	CI-19100	C 2640	CI-17600	C 2433

CI = Coefficient of strength for maximum fiber stress of 16000 lbs per sq in.

C = Coefficient of strength for maximum fiber stress of 1125 kgs per sq c.m.

For a single load concentrated at the centre of the beam take one half (½) the load given in the table.

Safe Loads in Kilograms and Pounds for Phœnix Steel Columns.
For Columns with Square End Bearings.— Segments "A."

Thickness	ins / mm	3/16	4·7	1/4	6·3	5/16	7·9	3/8	9·5
Area	sq ins / sq cm	3·8	24·5	4·8	30·9	5·8	37·4	6·8	43·8
Least Radius of Gyration	ins / mm	1·45	36·8	1·5	38·1	1·55	39·3	1·59	40·4
Length in metres	Length in feet	Safe Load in lbs	Safe Load in Kg	Safe Load in lbs	Safe Load in Kg	Safe Load in lbs	Safe Load in Kg	Safe Load in lbs	Safe Load in Kg
3	9842	46974	21307	59623	27045	72326	32807	84960	38538
3·5	11·483	45943	20840	58366	26475	70855	32140	83278	37775
4	13·123	44912	20372	57109	25905	69384	31473	81596	37012
4·5	14·764	43881	19904	55852	25335	67913	30806	79914	36249
5	16·404	42850	19436	54595	24765	66442	30139	78232	35486

Segments "B I."

Thickness	ins / mm	1/4	6·3	5/16	7·9	3/8	9·5	7/16	11·1	1/2	12·7	9/16	14·2	5/8	15·8
Area	sq ins / sq cm	6·4	41·3	7·8	50·3	9·2	59·3	10·6	68·3	12	77·4	13·4	86·4	10·8	95·4
Least Radius of Gyration	ins / m.m.	1·95	49·5	2·00	50·8	2·04	51·8	2·09	53·0	2·13	54·1	2·18	55·3	2·23	56·6
Length in metres	Length in feet	Safe Load in lbs	Safe Load in Kg	Safe Load in lbs	Safe Load in Kg	Safe Load in lbs	Safe Load in Kg	Safe Load in lbs	Safe Load in Kg	Safe Load in lbs	Safe Load in Kg	Safe Load in lbs	Safe Load in Kg	Safe Load in lbs	Safe Load in Kg
3	9·842	81724	37070	99736	45240	117921	53489	136104	61736	154506	70083	172802	78382	191133	86697
3·5	11·483	80419	36478	98159	44525	116125	52674	134095	60825	152275	69071	170364	77276	188486	85496
4	13·123	79101	35880	96582	43810	114329	51859	132083	59912	150044	68058	167919	76167	185839	84295
4·5	14·764	77783	35282	95005	43095	112533	51044	130071	59000	147813	67045	165479	75060	183192	83094
5	16·404	76465	34684	93428	42380	110737	50229	128059	58088	145582	66032	163039	73953	180545	81893
5·5	18·044	75147	34086	91851	41665	108941	49414	126047	57176	143351	65019	160599	72846	177898	80692
6	19·685	73829	33483	90274	40950	107145	48599	124035	56264	141120	64006	158159	71739	175251	79491
6·5	21·325	72511	32890	88697	40235	105349	47784	122023	55352	138889	62993	155719	70632	172604	78290
7	22·966	71193	32292	87120	39520	103553	46969	120011	54440	136658	61980	153279	69525	169957	77089
7·5	24·606	69875	31694	85543	38805	101757	46154	117999	53528	134427	60967	150839	68418	167310	75888

Table No. 7.

Safe Loads in Kilograms and Pounds for Phœnix Steel Columns.

For Columns with Square End Bearings.

Segments "B2."

Thickness.	ins. / mm.	1/4	6·3	5/16	7·9	3/8	9·5	7/16	11·1	1/2	12·7	9/16	14·2	5/8	15·8
Area.	sq ins. / sq cm.	7·4	47·7	9	58·0	10·6	68·3	12·2	78·7	13·8	89	15·4	99·3	17	109·6
Least Radius of Gyration.	ins. / m m.	2·39	60·7	2·43	61·7	2·48	63	2·52	64	2·57	65·2	2·61	66·2	2·66	67·5
Length in metres.	Length in feet.	Safe Load in lbs.	Safe Load in Kg.	Safe Load in lbs.	Safe Load in Kg.	Safe Load in lbs.	Safe Load in Kg.	Safe Load in lbs	Safe Load in Kg.	Safe Load in lbs.	Safe Load in Kg	Safe Load in lbs.	Safe Load in Kg.	Safe Load in lbs.	Safe Load in Kg.
3	9·842	96194	43633	117098	53115	138119	62650	159326	72269	180421	81838	201515	91406	222706	101018
3·5	11·483	94975	43080	115643	52455	136435	61886	157417	71404	178301	80876	199192	90352	220193	99878
4	13·123	93756	42527	114188	51795	134751	61124	155510	70540	176181	79913	196869	89298	217680	98738
4·5	14·764	92537	41974	112733	51135	133067	60361	153603	69675	174061	78951	194546	88244	215167	97598
5	16·404	91318	41421	111278	50475	131383	59598	151696	68810	171941	77989	192223	87190	212654	96458
5·5	18·044	90099	40868	109823	49815	129699	58835	149789	67945	169821	77027	189900	86136	210141	95318
6	19·685	88880	40315	108368	49155	128015	58072	147882	67080	167701	76065	187577	85082	207628	94178
6·5	21·325	87661	39762	106913	48495	126331	57309	145975	66215	165581	75103	185254	84028	205115	93038
7	22·966	86442	39209	105458	47835	124647	56546	144068	65350	163461	74141	182931	82974	202602	91898
7·5	24·606	85223	38656	104003	47175	122963	55783	142161	64485	161341	73179	180608	81920	200089	90758
8	26·247	84004	38103	102548	46515	121279	55020	140254	63620	159221	72217	178258	80866	197576	89618
8·5	27·887	82785	37550	101093	45855	119595	54257	138347	62755	157101	71255	175962	79812	195063	88478

Safe Loads in Kilograms and Pounds for Phœnix Steel Columns.

For Columns with Square End Bearings.

Segments "C."

Thickness.	ins. / m.m.	1/4	6·3	5/16	7·9	3/8	9·5	7/16	11·1	1/2	12·7	9/16	14·2	5/8	15·8
Area.	sq. ins / sq. cm	10	64·5	12·1	78·1	14·1	91·0	16	103·2	18	116·1	19·9	128·4	21·9	141·3
Least Radius of Gyration.	ins. / m.m.	2·84	72·1	2·88	73·1	2·93	74·4	2·97	75·4	3·01	76·4	3·06	77·7	3·11	79·0
Length in metres	Length in feet.	Safe Load in lbs.	Safe Load in Kg.	Safe Load in lbs.	Safe Load in Kg.	Safe Load in lbs.	Safe Load in Kg.	Safe Load in lbs	Safe Load in Kg.	Safe Load in lbs.	Safe Load in Kg.	Safe Load in lbs.	Safe Load in Kg.	Safe Load in lbs.	Safe Load in Kg.
3	9·842	131514	59654	157985	71661	184522	83698	211057	95734	237629	107787	253648	115053	280352	127166
3·5	11·483	130110	59017	156324	70908	182619	82835	208911	94761	235248	106707	251152	113921	277643	125937
4	13·123	128706	58380	154663	70155	180716	81972	206765	93788	232867	105627	248656	112789	274934	124708
4·5	14·764	127302	57743	153002	69402	178813	81109	204619	92815	230486	104547	246160	111657	272225	123479
5	16·404	125898	57106	151341	68649	176910	80246	202473	91842	228105	103467	243664	110525	269516	122250
5·5	18·044	124494	56469	149680	67896	175007	79383	200327	90869	225724	102387	241168	109393	266807	121021
6	19·685	123090	55832	148019	67143	173104	78520	198181	89896	223343	101307	238672	108261	264098	119792
6·5	21·325	121686	55195	146358	66390	171201	77657	196035	88923	220962	100227	236176	107129	261389	118563
7	22·966	120282	54558	144697	65637	169298	76794	193889	87950	218581	99147	233680	105997	258680	117334
7·5	24·606	118878	53921	143036	64884	167395	75931	191743	86977	216200	98067	231184	104865	255971	116105
8	26·247	117474	53284	141375	64131	165492	75068	189597	86004	213819	96987	228688	103733	253262	114876
8·5	27·887	116070	52647	139714	63378	163589	74205	187451	85031	211438	95907	226192	102601	250553	113647
9	29·528	114666	52010	138053	62625	161686	73342	185305	84058	209057	94827	223696	101469	247844	112418
9·5	31·168	113262	51373	136392	61872	159783	72479	183159	83085	206676	93747	221200	100337	245135	111189
10	32·808	111858	50736	134731	61119	157880	71616	181013	82112	204295	92667	218704	99205	242426	109960
105	34·449	110454	50099	133070	60366	155977	70753	178867	81139	201914	91587	216208	98073	239717	108731
11	36·089	109054	49462	131409	59613	154074	69890	176721	80166	199533	90507	213712	96941	237008	107502

Table No. 9.

Safe Loads in Kilograms and Pounds for Phœnix Steel Columns.

For Columns with Square End Bearings.

Segments "C."

Thickness	ins / m m.	11/16	17.4	3/4	19.0	13/16	20.6	7/8	22.2	1	25.4	1 1/8	28.5	1 1/4	31.7
Area	sq ins / sq cm	24.3	156.8	26.6	171.6	28.6	184.5	30.6	197.4	34.8	224.5	38.8	250.3	42.7	275.5
Least Radius of Gyration	ins. / m m	3.16	80.3	3.20	81.3	3.24	82.3	3.29	83.6	3.34	84.8	3.48	88.4	3.57	90.7
Length in metres.	Length in feet	Safe Load in lbs	Safe Load in Kg	Safe Load in lbs	Safe Load in Kg	Safe Load in lbs.	Safe Load in Kg.	Safe Load in lbs.	Safe Load in Kg	Safe Load in lbs.	Safe Load in Kg.	Safe Load in lbs.	Safe Load in Kg.	Safe Load in lbs.	Safe Load in Kg.
3	9.842	307031	139267	333748	151385	360567	163551	387421	175732	441074	200068	495128	224585	549082	249059
3.5	11.483	304105	137940	330607	149961	357232	162038	383896	174133	437161	198293	490858	222648	544474	246969
4	13.123	301179	136613	327466	148536	353897	160525	380371	172535	433248	196518	486588	220711	639866	244879
4.5	14.764	298253	135286	324325	147111	350562	159012	376846	170936	429335	194743	482318	218774	535258	242789
5	16.404	295327	133959	321184	145686	347227	157499	373321	169337	425422	192968	478048	216837	530650	240699
5.5	18.044	292401	132632	318043	144261	343892	155986	369796	167738	421509	191193	473778	214900	526042	238609
6	19.685	289475	131305	314902	142836	340557	154473	366271	166139	417596	189418	469508	212963	521434	236519
6.5	21.325	286549	129978	311761	141411	337222	152960	362746	164540	413683	187643	465238	211026	516826	234429
7	22.966	283623	128651	308620	139986	333887	151447	359221	162941	409770	185868	460968	209089	512218	232339
7.5	24.606	280697	127324	305479	138561	330552	149934	355696	161342	405857	184093	456698	207152	507610	230249
8	26.247	277771	125997	302338	137136	327217	148421	352171	159743	401944	182318	452428	205215	503002	228159
8.5	27.887	274845	124670	299197	135711	323882	146908	348646	158144	398031	180543	448158	203278	498394	226069
9	29.528	271919	123343	296056	134286	320547	145395	345121	156545	394118	178768	443888	201341	493786	223979
9.5	31.168	268993	122016	292915	132861	317212	143882	341596	154946	390205	176993	439618	199404	489178	221889
10	32.808	266067	120689	289774	131436	313877	142369	338071	153347	386292	175218	435348	197467	484570	219799
10.5	34.443	263141	119362	286633	130011	310542	140856	334546	151748	382379	173443	431078	195530	479962	217709
11	36.089	260215	118035	283492	128586	307207	139343	331021	150149	378466	171668	426808	193593	475354	215619

Table No. 10.

Safe Loads in Kilograms and Pounds for Phœnix Steel Columns.

For Columns with Square End Bearings.

Segments "E."

Thickness.	ins / m.m.	1/4	6·3	5/16	7·9	3/8	9·5	7/16	11·1	1/2	12·7	9/16	14·2	5/8	15·8
Area	sq ins / sq cm	16·5	106·4	19·1	123·2	21·7	139·9	24·7	159·3	27·6	177·9	30·6	197·3	33·5	216·1
Least Radius of Gyration.	ins / m.m.	4·20	10·66	4·25	10·79	4·29	10·89	4·34	11·02	4·38	11·13	4·43	11·25	4·48	11·37
Length in metres	Length in feet	Safe Load in lbs.	Safe Load in Kg	Safe Load in lbs	Safe Load in Kg	Safe Load in lbs	Safe Load in Kg	Safe Load in lbs	Safe Load in Kg	Safe Load in lbs	Safe Load in Kg	Safe Load in lbs	Safe Load in Kg	Safe Load in lbs	Safe Load in Kg
3	9·842	221584	100509	256701	116438	291605	132270	332203	150685	371139	168347	411790	186785	451215	204668
3·5	11·483	220037	99807	254931	115636	289614	131367	329963	149669	368663	167223	409072	185552	448270	203332
4	13·123	218490	99105	253161	114832	287623	130464	327723	148653	366187	166100	406354	184319	445325	201996
4·5	14·764	216943	98403	251391	114029	285632	129561	325483	147637	363711	164977	403636	183086	442380	200660
5	16·404	215396	97701	249621	113226	283641	128658	323243	146621	361235	163854	400918	181853	439435	199324
5·5	18·044	213849	96999	247851	112423	281650	127755	321003	145605	358759	162731	398200	180620	436490	197988
6	19·685	212302	96297	246081	111620	279659	126852	318763	144589	356283	161608	395482	179387	433345	196652
6·5	21·325	210755	95595	244311	110817	277668	125949	316523	143573	353807	160485	392764	178154	430600	195316
7	22·966	209208	94893	242541	110014	275677	125046	314283	142557	351331	159362	390046	176921	427655	193980
7·5	24·606	207661	94191	240771	109211	273686	124143	312043	141541	348855	158239	387328	175688	424710	192644
8	26·247	206114	93489	239001	108408	271695	123240	309803	140525	346379	157116	384610	174455	421765	191308
8·5	27·887	204567	92787	237231	107605	269704	122337	307563	139509	343903	155993	381892	173222	418820	189972
9	29·528	203020	92085	235461	106802	267713	121434	305323	138493	341427	154870	379174	171989	415875	188636
9·5	31·168	201473	91383	233691	105999	265722	120531	303083	137477	338951	153747	376456	170756	412930	187300
10	32·808	199926	90681	231921	105196	263731	119628	300843	136461	336475	152624	373738	169523	409985	185964
10·5	34·449	198379	89979	230151	104393	261740	118725	298603	135445	333999	151501	371020	168290	407040	184628
11	36·089	196832	89277	228381	103590	259749	117822	296363	134429	331523	150378	368302	167057	404095	183292
11·5	37·730	195285	88575	226611	102787	257758	116919	294123	133413	329047	149255	365584	165824	401150	181956
12	39·370	193738	87873	224841	101984	255767	116016	291883	132397	326571	148132	362866	164591	398205	180620

Table No. 11.

Safe Loads in Kilograms and Pounds for Phœnix Steel Columns.

For Columns with Square End Bearings.

Segments "E."

Thickness.	ins / mm	11/16	17·4	3/4	19·0	13/16	20·6	7/8	22·2	1	25·4	1 1/8	28·5	1 1/4	31·7
Area	sq ins / sq.c.m.	36·4	234·7	40	258	43	277·4	45·9	296·1	51·7	333·5	57·6	371·5	63·5	409·6
Least Radius of Gyration	ins. / m.m.	4·52	114·8	4·56	115·8	4·61	117·1	4·66	118·3	4·73	120·1	4·84	122·9	4·93	125·2
Length in metres.	Length in feet	Safe Load in lbs	Safe Load in Kg.	Safe Load in lbs	Safe Load in Kg	Safe Load in lbs.	Safe Load in Kg.	Safe Load in lbs	Safe Load in Kg	Safe Load in lbs	Safe Load in Kg	Safe Load in lbs	Safe Load in Kg	Safe Load in lbs	Safe Load in Kg
3	9·842	490240	222368	539088	244526	579866	263024	619191	280864	697797	316517	777969	352880	858327	389329
3·5	11·483	487075	220932	535642	242963	576189	261356	615313	279104	693494	314565	773284	350755	853258	387030
4	13·123	483910	219496	532196	241400	572512	259688	611435	277345	689191	312613	768599	348630	848189	384731
4·5	14·764	480745	218060	528750	239837	568835	258020	607557	275586	684888	310661	763914	346505	843120	382432
5	16·404	477580	216624	525304	238274	565158	256352	603679	273827	680583	308709	759229	344380	838051	380133
5·5	18·044	474415	215188	521858	236711	561481	254684	599801	272068	676282	306757	754544	342255	832982	377834
6	19·685	471250	213752	518412	235148	557804	253016	595923	270309	671979	304805	749859	340130	827913	375535
5·5	21·325	468085	212316	514966	233585	554127	251348	592045	268550	667676	302853	745174	338005	822844	373236
7	22·966	464920	210880	511520	232022	550450	249680	588167	266791	663373	300901	740489	335880	817775	370937
7·5	24·606	461755	209444	508074	230459	546773	248012	584287	265032	659070	298949	735804	333755	812706	368638
8	26·247	458590	208008	504628	228896	543096	246344	580411	263273	654767	296997	731119	331630	807637	366339
8·5	27·887	455425	206572	501182	227333	539419	244676	576533	261514	650464	295045	726434	329505	802568	364040
9	29·528	452260	205136	497736	225770	535742	243008	572655	259755	646161	293093	721749	327380	797499	361741
9·5	31·168	449095	203700	494290	224207	532065	241340	568777	257996	641858	291141	717064	325255	792430	359442
10	32·808	445930	202264	490844	222644	528388	239672	564899	256237	637555	289189	712379	323130	787361	357143
10·5	34·449	442765	200828	487398	221081	524711	238004	561021	254478	633252	287237	707694	321005	782292	354844
11	36·089	439600	199392	483952	219518	521034	236336	557143	252719	628949	285285	703009	318880	777223	352545
11·5	37·730	436435	197956	480506	217955	517357	234668	553265	250960	624646	283333	698324	316755	772154	350246
12	39·370	433270	196520	477060	216392	513680	233000	549387	249201	620343	281381	693639	314630	767085	347947

Table No. 12.

Safe Loads in Kilograms and Pounds for Phœnix Steel Columns.

For Columns with Square End Bearings.

Segments "G."

Thickness.	ins. / m.m.	5/16	7·9	3/8	9·5	7/16	11·1	1/2	12·7	9/16	14·2	5/8	15·8	11/16	17·4
Area	sq. ins. / sq. c.m.	24·2	156·1	28·1	181·2	32	206·4	36	232·2	39·9	257·4	43·8	282·5	47·7	307·7
Least Radius of Gyration.	ins. / m.m.	5·54	140·7	5·59	141·9	5·64	143·2	5·68	144·2	5·73	145·5	5·77	146·5	5·82	147·8
Length in metres.	Length in feet	Safe Load in lbs.	Safe Load in Kg.	Safe Load in lbs.	Safe Load in Kg.	Safe Load in lbs	Safe Load in Kg	Safe Load in lbs	Safe Load in Kg	Safe Load in lbs	Safe Load in Kg.	Safe Load in lbs.	Safe Load in Kg.	Safe Load in lbs.	Safe Load in Kg.
3	9·842	328387	148954	381289	172950	435322	197459	488854	221739	542053	245871	595032	269903	648284	294057
3·5	11·483	326667	148174	379311	172053	433025	196417	486358	220607	539313	244628	592043	268547	645059	292594
4	13·123	324947	147394	377333	171156	430728	195375	483862	219475	536573	243385	589084	267191	641834	291131
4·5	14·764	323227	146614	375355	170259	428431	194333	481366	218343	533833	242142	586065	265835	638609	289668
5	16·404	321507	145834	373377	169362	426134	193291	478870	217211	531093	240899	583076	264479	635384	288205
5·5	18·044	319787	145054	371399	168465	423837	192249	476374	216079	528353	239656	580087	263123	632159	286742
6	19·685	318067	144274	369421	167568	421540	191207	473878	214947	525613	238413	577098	261767	628334	285279
6·5	21·325	316347	143494	367443	166671	419243	190165	471382	213815	522873	237170	574109	260411	625709	263816
7	22·966	314627	142714	365465	165774	416946	189123	468886	212683	520133	235927	571120	259055	622484	282353
7·5	24·606	312907	141934	363487	164877	414649	188081	466390	211551	517393	234684	568131	257699	619259	280890
8	26·247	311187	141154	361509	163980	412352	187039	463894	210419	514653	233441	565142	256343	616034	279427
8·5	27·887	309467	140374	359531	163083	410055	185997	461398	209287	511913	232198	562153	254987	612809	277964
9	29·528	307747	139594	357553	162186	407758	184955	458902	208155	509173	230955	559164	253631	609584	276501
9·5	31·168	306027	138814	355575	161289	405461	183913	456406	207023	506433	229712	556175	252275	606359	275038
10	32·808	304307	138034	353597	160392	403164	182871	453910	205891	503693	228469	553186	250919	603134	273575
10·5	34·449	302587	137254	351619	159495	400867	181829	451414	204759	500953	227226	550197	249563	599909	272112
11	36089	300867	136474	349641	158598	398570	180787	448918	203627	498213	225983	547208	248207	596684	270649
11·5	37·730	299147	135694	347663	157701	396273	179745	446422	202495	495473	224740	544219	246851	593459	269186
12	39·370	297427	134914	345685	156804	393976	178703	443926	201363	492733	223497	541230	245495	590234	267723

Table No. 13.

Safe Loads in Kilograms and Pounds for Phœnix Steel Columns.

For Columns with Square End Bearings.

Segments "G."

Thickness	ins. mm	3/4	19·0	13/16	20·6	7/8	22·2	1	25·4	1 1/8	28·5	1 1/4	31·7	1 3/8	34·9
Area	sq. ins. sq. c.m.	51·7	333·5	55·6	358·7	59·6	384·5	67·4	434·8	75·3	485·7	83·1	536·1	90·9	586·4
Least Radius of Gyration	ins. m.m.	5·88	149·3	5·91	150·1	5·95	151·1	6·04	153·4	6·13	155·6	6·27	159·2	6·32	160·5
Length in metres.	Length in feet.	Safe Load in lbs	Safe Load in Kg.	Safe Load in lbs.	Safe Load in Kg.	Safe Load in lbs.	Safe Load in Kg	Safe Load in lbs	Safe Load in Kg	Safe Load in lbs.	Safe Load in Kg.	Safe Load in lbs	Safe Load in Kg	Safe Load in lbs.	Safe Load in Kg.
3	9·842	702848	318808	756175	342996	810617	367691	917060	415974	1024842	464859	1131911	513425	1238390	561724
3·5	11·483	699387	317238	752482	341321	806689	365910	912668	413982	1020005	462665	1126692	511058	1232725	559156
4	13·123	695926	315668	748789	339646	802763	364129	908277	411990	1015168	460471	1121474	508691	1227060	556588
4·5	14·764	692465	314098	745096	337971	798837	362348	903885	409998	1010331	458277	1116256	506324	1221395	554020
5	16·404	689004	312528	741403	336296	794911	360567	899493	408006	1005494	456083	1111038	503957	1215730	551452
5·5	18·044	685543	310958	737710	334621	790985	358786	895101	406014	1000657	453889	1105820	501590	1210065	548884
6	19·685	682082	309388	734017	332946	787059	357005	890709	404022	995820	451695	1100602	499223	1204400	546316
6·5	21·325	678621	307818	730324	331271	783133	355224	886317	402030	990983	449501	1095384	496856	1198735	543748
7	22·966	675160	306248	726631	329596	779207	353443	881925	400038	986146	447307	1090166	494489	1193070	541180
7·5	24·606	671698	304678	722938	327921	775281	351662	877533	398046	981309	445113	1084948	492122	1187405	538612
8	26·247	668238	303108	719245	326246	771355	349881	873141	396054	976472	442919	1079730	489755	1181740	536044
8·5	27·887	664777	301538	715552	324571	767429	348100	868749	394062	971635	440725	1074512	487388	1176075	533476
9	29·528	661316	299968	711859	322896	763503	346319	864357	392070	966798	438531	1069294	485021	1170410	530908
9·5	31·168	657855	298398	708166	321221	759577	344538	859965	390078	961961	436337	1064076	482654	1164745	528340
10	32·808	654394	296828	704473	319546	755651	342757	855573	388086	957124	434143	1058858	480287	1159080	525772
10·5	34·449	650933	295258	700780	317871	751725	340976	851181	386094	952287	431959	1053640	477920	1153415	523204
11	36·089	647472	293688	697087	316196	747799	339195	846789	384102	947450	429765	1048422	475553	1147750	520636
11·5	37·730	644011	292118	693394	314521	743873	337414	842397	382110	942613	427571	1043204	473186	1142085	518068
12	39·370	640550	290548	689701	312846	739947	335633	838005	380118	937776	425377	1037986	470819	1136420	515500

Table of Safe Loads for 12″ (304·8 m.m) Z-Bar Columns.

Allowed stresses per sq. in. safety factor 4. { 12,000 lbs. for lengths of 90 radii or under. 17,100−57 $\frac{l}{r}$ for lengths over 90 radii.

Allowed stresses per sq. c.m. safety factor 4. { 843·7 Kgs. for lengths of 90 radii or under. ·0703 (17,100−57 $\frac{l}{r}$) for lengths over 90 radii.

Thickness	ins. / m.m.	3/8	9·5	1/2	12·7	5/8	15·8	3/4	19	7/8	22·2
Weight	lbs per ft. / Kg. per M.	72·7	108·2	97·8	145·5	118·5	176·3	137·8	205·1	162·1	241·2
Area	sq. ins. / sq. c.m.	21·4	138·0	28·8	185·8	34·8	224·5	40·5	261·2	47·70	307·7
Least Radius of Gyration.	ins. / m.m.	3·67	93·2	3·77	95·1	3·75	95·2	3·68	93·4	3·64	92·4
Length in metres.	Length in feet	Safe Load in lbs.	Safe Load in Kg.	Safe Load in lbs.	Safe Load in Kg.	Safe Load in lbs.	Safe Load in Kg.	Safe Load in lbs.	Safe Load in Kg.	Safe Load in lbs.	Safe Load in Kg.
8	26·247	256681	116430	345591	156759	417573	189410	485836	220374	572327	259606
8·5	27·887	254543	115460	345591	156759	417573	189410	482258	218751	565446	256485
9	29·528	248004	112494	336948	152839	407482	184833	469912	213151	550742	249815
9·5	31·168	241467	109529	328375	148950	397066	180108	457566	207551	536038	243144
10	32·808	234930	106564	319802	145061	386650	175383	445220	201951	521334	236474
10·5	34·449	228393	103599	311229	141172	376234	170658	432874	196351	506630	229804
11	36·089	221856	100634	302656	137283	365818	165933	420528	190751	491926	223134
11·5	37·729	215319	97669	294083	133394	355402	161208	408182	185151	477222	216464
12	39·370	208782	94·704	285510	129505	344986	156483	395836	179551	462518	209794
12·5	41·010	202245	91·739	276937	125616	334570	151758	383490	173951	447814	203124

Table No. 15.

Table of Safe Loads for 10″ (254 mm) Z-Bar Columns.

Allowed stresses per sq in. safety factor 4: { 12,000 lbs for lengths of 90 radii or under. 17,100 − 57 $\frac{l}{r}$ for lengths over 90 radii.

Allowed stresses per sq c.m. safety factor 4: { 843.7 Kgs for lengths of 90 radii or under. ·0703 (17,100 − 57 $\frac{l}{r}$) for lengths over 90 radii.

Thickness	ins. / m.m	5/16	7.9	7/16	11.1	9/16	14.2	11/16	17.4	13/16	20.6
Weight	lbs per ft / Kg per M	53.7	79.9	75.8	112.8	94.2	140.3	111	165.2	132.6	197.3
Area	sq ins. / sq c.m	15.8	101.9	22.3	143.8	27.7	178.7	32.7	210.9	39	251.6
Least Radius of Gyration.	ins. / m.m.	3.08	78.2	3.18	80.7	3.15	80	3.13	79.5	3.25	82.5
Length in metres.	Length in feet.	Safe Load in lbs.	Safe Load in Kg.	Safe Load in lbs	Safe Load in Kg	Safe Load in lbs.	Safe Load in Kg	Safe Load in lbs.	Safe Load in Kg	Safe Load in lbs	Safe Load in Kg.
7	22.966	189536	85973	267470	121324	332375	150769	392277	177936	467981	212275
7.5	24.606	183720	83335	263039	119314	325595	147689	383166	173803	464736	210803
8	26.247	177966	80725	255171	115745	315727	143213	371446	168487	451266	204693
8.5	27.887	172212	78115	247303	112175	305859	138738	359726	163171	437796	198583
9	29.528	166458	75505	239435	108605	295991	134263	348006	157855	424326	192473
9.5	31.168	160704	72895	231567	105035	286123	129788	336286	152539	410856	186363
10	32.808	154950	70285	223699	101465	276255	125313	324566	147223	397386	180253
10.5	34.449	149196	67675	215831	97895	266387	120838	312846	141907	383916	174143
11	36.089	143442	65065	207963	94325	256519	116363	301126	136591	370446	168033
11.5	37.729	137688	62455	200095	90755	246651	111888	289406	131275	356976	161923
12	39.370	131934	59845	192227	87185	236783	107413	277686	125959	343506	155813
12.5	41.010	126180	57235	184359	83615	226915	102938	265966	120643	330036	149703

Table No. 16.

Table of Safe Loads for 8(203·2 m.m.) Z-Bar Columns.

Allowed stresses per sq. in. safety factor 4: { 12000 lbs. for lengths of 90 radii or under; $17100 - 57\frac{l}{r}$ for lengths over 90 radii.

Allowed stresses per sq. c.m. safety factor 4: { 843·7 Kgs for lengths of 90 radii or under; $0703\,(17100 - 57\frac{l}{r})$ for lengths over 90 radii.

Thickness.	ins / mm	1/4	6·3	3/8	9·5	1/2	12·7	5/8	15·8	3/4	19
Weight.	lbs per ft. / Kgs per M.	3·83	5·7	5·8	8·63	7·37	10·96	8·92	13·27	10·84	16·13
Area.	sq. ins. / sq. c.m.	1·13	7·29	1·71	11·03	2·19	14·12	2·63	16·96	3·19	20·58
Least Radius of Gyration.	ins. / m.m.	2·47	62·7	2·57	65·2	2·55	64·7	2·52	64	2·63	66·8
Length in metres.	Length in feet.	Safe Load in lbs.	Safe Load in Kgs.	Safe Load in lbs.	Safe Load in Kgs.	Safe Load in lbs.	Safe Load in Kgs.	Safe Load in lbs.	Safe Load in Kgs.	Safe Load in lbs.	Safe Load in Kgs.
5·5	18·045	135594	61505	205160	93060	262634	119130	315458	143091	382791	173633
6	19·685	131575	59682	202649	91921	258681	117337	309014	140168	382116	173327
6·5	21·325	126443	57354	195177	88532	249038	112963	297314	134861	368498	167150
7	22·966	121311	55026	187705	85143	239395	108588	285614	129553	354880	160973
7·5	24·606	116179	52698	180233	81754	229752	104214	273914	124246	341262	154798
8·	26·247	111047	50370	172761	78365	220109	99840	262214	118939	327644	148622
8·5	27·887	105915	48042	165289	74976	210466	95466	250514	113632	314026	142446
9·	29·528	100783	45714	157817	71587	200823	91092	238814	108325	300408	136270
9·5	31·168	95651	43386	150345	68198	191180	86718	227114	103018	286790	130094
10·	32·809	90519	41058	142873	64809	181537	82344	215414	97711	273172	123918
10·5	34·449	85387	38730	135401	61420	171894	77970	203714	92404	259554	117742
11·	36·089	80255	36402	127929	58031	162251	73596	192014	87097	245936	111566
11·5	37·729	75123	34074	120457	54642	152608	69222	180314	81790	232318	105390
12·	39·370	69991	31746	112985	51253	142965	64848	168614	76483	218700	99214

Table No. 17.

Table of Safe Loads for 6" (152·39 m.m.) Z-Bar Columns.

Allowed stresses per sq. in. safety factor 4: 12000 lbs. for lengths of 90 radii or under. 17,100 − 57 $\frac{l}{r}$ for lengths over 90 radii.

Allowed stresses per sq. c.m. safety factor 4: 843·7 Kgs. for lengths of 90 radii or under. ·0703 (17,100 − 57 $\frac{l}{r}$) for lengths over 90 radii.

Thickness.	ins. / m.m.	1/4	6·3	5/16	7·9	3/8	9·5	7/16	11·1	1/2	12·7	9/16	14·2
Weight.	lbs. per ft. / Kgs. per M.	31·7	47·2	39·8	59·2	46·2	68·7	54·3	80·8	59·9	89·1	67·9	101
Area.	sq. ins. / sq. c.m.	9·31	60	11·7	75·4	13·6	87·7	16	103·2	17·6	113·5	20	129
Least Radius of Gyration.	ins. / m.m.	1·86	47·2	1·90	48·2	1·88	47·7	1·93	49	1·90	48·2	1·95	49·5
Length in metres.	Length in feet.	Safe Load in lbs.	Safe Load in Kgs.	Safe Load in lbs.	Safe Load in Kgs.	Safe Load in lbs.	Safe Load in Kgs.	Safe Load in lbs.	Safe Load in Kgs.	Safe Load in lbs.	Safe Load in Kgs.	Safe Load in lbs.	Safe Load in Kgs.
4	13·123	111600	50621	140245	63615	163122	73992	191954	87070	211112	95760	239942	108837
4·5	14·764	108479	49206	137639	62433	159333	72273	189778	86083	207190	93981	238280	108083
5	16·404	102864	46659	130730	59299	151213	68590	180475	81863	196789	89263	226767	102861
5·5	18·044	97249	44112	123821	56165	143093	64907	171173	77643	186388	84545	215254	97639
6	19·685	91634	41565	116912	53031	134973	61224	161870	73423	175987	79827	203741	92417
6·5	21·325	86019	39018	110003	49897	126853	57541	152567	69203	165586	75109	192228	87195
7	22·966	80404	36471	103094	46763	118733	53858	143264	64983	155185	70391	180715	81973
7·5	24·606	74789	33924	96185	43629	110613	50175	133961	60763	144784	65673	169202	76751
8	26·247	69174	31377	89276	40495	102493	46492	124658	56543	134383	60955	157689	71529
8·5	27·887	63559	28830	82367	37361	94373	42809	115355	52323	123982	56237	146176	66307
9	29·528	57944	26283	75458	34227	86253	39126	106052	48103	113581	51519	134663	61085

Table No. 18.

Safe Loads in Thousands of Kilograms and Pounds for Round Cast Iron Columns.

Allowed stresses in lbs. per sq. inch. $\left\{ \dfrac{10000}{1+\dfrac{L^2}{800\,d^2}} \right.$
Factor of Safety 8.

d = diam. in inches.
L = length in inches.

Allowed stresses in Kilos per sq. c.m. $\left\{ \dfrac{703}{1+\dfrac{L^2}{800\,d^2}} \right.$
Factor of Safety 8.

d = diam. in metres.
L = length in metres.

14" Outside diam. of Column 355·6 m.m.

Area. sq. ins / sq. c.m		263·5	40·8	323·1	50·1	380	58·9	434·5	67·3	486·4	75·4
Thickness ins / m.m		25·4	1	31·7	1¼	31·8	1½	44·44	1¾	50·8	2
Length.		Safe Load.		Safe Load		Safe Load.		Safe Load		Safe Load	
Metres	Feet	Kgs.	lbs.	Kgs.	lbs.	Kgs.	lbs.	Kgs.	lbs.	Kgs.	lbs.
4	13·123	160	353	196	432	231	509	264	582	295	651
4·5	14·764	154	340	189	417	223	491	255	261	285	628
5	16·404	149	328	182	402	214	472	245	540	274	605
5·5	18·044	143	314	175	385	206	454	235	519	263	580
6	19·685	137	301	168	369	197	434	225	497	252	556
6·5	21·325	131	289	161	354	189	417	216	477	242	534
7	22·966	125	275	153	337	180	397	206	454	230	508
7·5	24·606	119	263	147	323	172	379	196	433	220	485
8	26·247	114	250	139	307	164	360	187	413	210	462
8·5	27·887	108	238	133	292	156	344	178	393	200	440

15" Outside diam. of Column 381 m.m.

Area sq. ins / sq. c.m		283·8	44	348·4	54	410·4	63·6	470	72·8	526·9	81·6
Thickness ins. / m.m		25·4	1	31·7	1¼	38·1	1½	44·4	1¾	50·8	2
Length.		Safe Load.		Safe Load		Safe Load		Safe Load.		Safe Load	
Metres	Feet	Kgs.	lbs.	Kgs.	lbs.	Kgs.	lbs.	Kgs.	lbs.	Kgs.	lbs.
4	13·123	175	387	215	475	254	559	290	640	326	718
4·5	14·764	170	375	209	460	246	542	281	620	316	696
5	16·404	163	362	202	444	238	524	272	599	305	672
5·5	18·044	158	349	194	428	229	505	262	578	294	648
6	19·685	152	336	187	413	220	486	252	556	283	624
6·6	21·325	146	323	180	396	212	467	242	534	272	599
7	22·966	140	309	172	380	203	447	232	512	260	574
7·5	24·606	134	296	165	364	194	429	223	491	350	550
8	26·247	129	284	158	348	186	410	213	470	239	527
8·5	27·887	123	271	151	333	178	392	204	449	228	504
9	29·527	118	259	144	318	170	375	194	429	218	481

Table No. 19.

Safe Loads in Thousands of Kilograms and Pounds for Round Cast Iron Columns.

Allowed stresses in lbs. per sq. inch. $\left\{ \dfrac{10000}{1+\dfrac{L^2}{800\,d^2}} \right.$ Factor of Safety 8.

d = diam. in inches.
L = length in inches.

Allowed stresses in Kilos per sq. c.m. $\left\{ \dfrac{703}{1+\dfrac{L^2}{800\,d^2}} \right.$ Factor of Safety 8.

d = diam. in metres.
L = length in metres.

12" Outside diam. of Column. 304·8 m.m.

Area	sq ins		26·5		34·6		42·2		49·5		56·4		62·8
	sq cm	171·0		222·9		272·3		319·2		363·5		405·3	
Thickness	ins		3/4		1		1¼		1½		1¾		2
	m m	19·0		25·4		31·7		38·1		44·4		50·8	
Length.		Safe Load		Safe Load.		Safe Load		Safe Load.		Safe Load		Safe Load.	
Metres	Feet	Kgs	lbs.	Kgs.	lbs.	Kgs.	lbs	Kgs.	lbs.	Kgs.	lbs	Kgs.	lbs.
3·5	11·483	104	228	135	297	164	362	193	425	219	484	245	539
4	13·123	99	218	129	284	158	347	185	407	210	464	235	517
4·5	14·764	95	208	123	272	151	332	176	389	201	443	224	494
5	16·404	90	198	117	259	143	316	168	370	191	422	213	470
5·5	18·044	86	188	111	246	136	300	160	352	182	401	203	447
6	19·685	81	179	106	233	129	284	151	333	172	380	192	423
6·5	21·325	76	169	100	221	122	269	143	315	163	359	181	401
7	22·966	73	160	95	208	115	254	135	298	154	340	172	379
7·5	24·606	68	151	89	197	109	240	128	282	146	321	162	358
8	26·247	65	143	84	186	103	227	121	266	137	303	153	338

13" Outside diam. of Column. 330·2 m.m.

Area.	sq ins		37·7		46·1		54·2		61·9		69·1
	sq c m	243·2		297·6		349·6		399·0		445·9	
Thickness	ins.		1		1¼		1½		1¾		2
	m m.	25·4		31·75		38·1		44·4		50·8	
Length.		Safe Load.		Safe Load		Safe Load		Safe Load		Safe Load	
Metres.	Feet.	Kgs.	lbs.	Kgs	lbs.	Kgs.	lbs.	Kgs.	lbs	Kgs.	lbs.
4	13·123	145	319	177	390	208	458	237	523	264	584
4·5	14·764	139	306	170	375	200	440	228	502	254	561
5	16·404	133	293	163	359	191	421	218	481	244	537
5·5	18·044	127	280	155	343	183	402	208	459	233	514
6	19·685	121	267	148	327	174	384	199	438	222	489
6·5	21·325	115	254	141	311	166	365	189	417	211	466
7	22·966	110	241	134	296	157	347	180	396	201	443
7·5	24·606	104	229	127	281	149	330	171	376	191	420
8	26·247	99	217	121	266	142	313	161	357	181	390
8·5	27·887	94	206	115	252	134	296	154	338	167	378

Table No. 20.

Safe Loads in Thousands of Kilograms and Pounds for Round Cast Iron Columns.

Allowed stresses in lbs. per sq inch. Factor of Safety 8. $\left\{ \dfrac{10000}{1+\dfrac{l^2}{800\,d^2}} \right.$

d = diam. in inches.
l = length in inches.

Allowed stresses in Kilos per sq c.m. Factor of Safety 8. $\left\{ \dfrac{703}{1+\dfrac{l^2}{800\,d^2}} \right.$

d = diam. in metres.
l = length in metres.

10" Outside diam. of Column. 254 m.m.

Area	sq ins / sq cm	140·6	21·8	182·6	28·3	221·3	34·3	258	40	292·5	45·35	323·8	50·2
Thickness	ins / m.m	19	¾	25·4	1	31·7	1¼	38·1	1½	44·4	1¾	50·8	2
Length.		Safe Load.		Safe Load		Safe Load.		Safe Load.		Safe Load		Safe Load.	
Metres	Feet	Kgs.	lbs.	Kgs.	lbs.	Kgs.	lbs.	Kgs.	lbs.	Kgs.	lbs.	Kgs.	lbs.
3·5	11·483	80	176	104	229	126	277	146	323	166	366	184	405
4	13·123	75	167	98	216	119	262	139	306	157	347	174	384
4·5	14·764	71	157	92	203	112	247	130	288	148	326	164	361
5	16·404	67	147	86	191	105	231	122	269	138	305	153	338
5·5	18·044	62	137	81	178	98	216	114	252	129	286	143	316
6	19·685	58	128	76	167	92	202	107	236	121	267	134	296
6·5	21·325	54	120	71	156	86	189	100	220	113	249	125	276
7	22·966	51	112	66	145	80	176	93	205	105	232	117	257
7·5	24·606	47	104	61	136	74	164	87	192	98	217	109	240
8	26·247	44	97	57	126	69	153	81	179	92	202	102	224

11" Outside diam. of Column. 279·4 m.m.

Area	sq ins / sq cm	155·5	24·1	202·6	31·4	247·1	38·3	289	44·8	328·4	50·9	364·5	56·5
Thickness	ins. / m.m	19	¾	25·4	1	31·7	1¼	38·1	1½	44·4	1¾	50·8	2
Length.		Safe Load		Safe Load		Safe Load		Safe Load		Safe Load		Safe Load.	
Metres	Feet	Kgs.	lbs.	Kgs.	lbs.	Kgs.	lbs.	Kgs.	lbs.	Kgs.	lbs.	Kgs.	lbs.
3·5	11·483	91	202	119	263	145	320	170	375	193	426	214	473
4	13·123	87	192	113	250	138	305	162	357	184	406	204	450
4·5	14·764	83	182	108	237	131	289	153	338	174	384	194	427
5	16·404	78	172	102	224	124	274	145	320	165	364	183	404
5·5	18·044	74	162	96	211	117	258	137	302	155	343	173	380
6	19·685	69	153	90	199	110	243	129	284	146	323	162	358
6·5	21·325	65	144	85	187	104	228	121	267	138	303	153	337
7	22·966	61	135	80	176	97	214	114	251	129	285	143	316
7·5	24·606	58	127	75	166	92	202	107	236	122	268	135	298
8	26·247	54	119	70	155	86	189	100	222	114	252	127	279
8·5	27·887	51	112	66	146	81	178	94	208	107	236	119	262

Table No. 21.

Safe Loads in Thousands of Kilograms and Pounds for Round Cast Iron Columns.

Allowed stresses in lbs per sq inch $\left\{ \dfrac{10000}{1+\dfrac{l^2}{800\,d^2}} \right.$
Factor of Safety 8

d = diam in inches.
l = length in inches.

Allowed stresses in Kilos per sq. c.m. $\left\{ \dfrac{703}{1+\dfrac{l^2}{800\,d^2}} \right.$
Factor of Safety 8

d = diam. in metres.
l = length in metres.

8" Outside diam. of Column. 203.2 m.m.

Area (sq ins / sq c m)		110.3	17.1	141.9	22	170.9	26.5	197.4	30.6	221.2	34.3	243.2	37.7
Thickness (ins. / m m)		19	3/4	25.4	1	31.7	1¼	38.1	1½	44.44	1¾	50.8	2
Length.		Safe Load		Safe Load.		Safe Load		Safe Load.		Safe Load		Safe Load	
Metres	Feet.	Kgs	lbs.	Kgs.	lbs.	Kgs.	lbs.	Kgs	lbs.	Kgs.	lbs.	Kgs.	lbs.
2.5	8.202	65.2	143.8	83.9	185.0	101.1	222.9	116.8	257.3	130.8	288.5	143.8	317.1
3	9.842	61.1	134.6	78.6	173.2	94.6	208.7	109.3	240.9	122.5	270.1	134.6	296.8
3.5	11.483	56.6	124.9	72.9	160.7	87.8	193.6	101.4	223.5	113.6	250.5	124.9	275.4
4	13.123	52.3	115.5	67.4	148.6	81.2	179.0	93.7	206.7	105.0	231.7	115.5	254.7
4.5	14.764	48.2	106.2	61.9	136.6	74.6	164.6	86.2	190.1	96.6	213.0	106.2	234.2
5	16.404	44.3	97.3	56.8	125.2	68.4	150.9	79.0	174.2	88.6	195.3	97.3	214.6
5.5	18.044	40.6	89.5	52.2	115.2	62.9	138.7	72.6	160.2	81.4	179.6	89.5	197.4
6	19.685	37.1	81.9	47.8	105.4	57.6	127.0	66.5	146.6	74.5	164.3	81.9	180.6

9" Outside diam. of Column. 228.6 m.m.

Area (sq ins / sq c m)		125.1	19.4	161.9	25.1	196.1	30.4	227.7	35.3	257.4	39.9	283.8	44
Thickness (ins. / m.m.)		19	3/4	25.4	1	31.7	1¼	38.1	1½	44.44	1¾	50.8	2
Length.		Safe Load.		Safe Load.		Safe Load.		Safe Load.		Safe Load.		Safe Load.	
Metres	Feet.	Kgs.	lbs.	Kgs.	lbs.	Kgs.	lbs.	Kgs.	lbs.	Kgs.	lbs.	Kgs.	lbs.
3	9.842	72.4	159.8	93.8	206.7	113.6	250.4	131.9	290.8	149.1	328.6	164.3	362.4
3.5	11.483	68.1	150.2	88.1	192.3	106.7	235.3	123.9	273.2	140.0	308.8	154.4	340.6
4	13.123	63.6	140.4	82.4	181.6	99.8	220.0	115.8	255.4	130.9	228.7	144.4	318.4
4.5	14.764	59.2	130.6	76.7	169.0	92.9	204.7	107.8	237.7	121.8	268.6	134.4	296.2
5	16.404	55.0	121.2	71.2	156.9	86.2	190.0	100.1	220.6	113.1	249.3	124.7	275.0
5.5	18.044	51.1	112.8	66.2	145.9	80.1	176.7	93.1	205.2	105.2	232.0	116.0	255.8
6	19.685	47.4	104.4	61.3	135.1	74.3	163.6	86.2	190.0	97.5	214.7	107.4	236.8
6.5	21.325	43.8	96.6	56.7	125.0	68.6	151.4	79.7	175.8	90.5	198.7	99.3	219.1
7	22.966	40.5	89.4	52.4	115.7	63.5	140.1	73.7	162.7	83.4	183.8	91.9	202.7
7.5	24.606	37.5	82.8	48.6	107.1	58.8	129.7	68.3	150.6	77.2	170.2	85.1	187.7

Table No. 22.

Allowed stresses in lbs per sq. inch. $\left\{ \frac{10000}{1+\frac{L^2}{800\,d^2}} \right.$
Factor of Safety 8

d = diam. in inches.
L = length in inches.

Safe Loads in Thousands of Kilograms and Pounds
for
Round Cast Iron Columns.

Allowed stresses in Kilos. per sq. c.m. $\left\{ \frac{703}{1+\frac{L^2}{800\,d^2}} \right.$
Factor of Safety 8.

d = diam. in metres.
L = length in metres.

6" Outside diam. of Column. 152·4 m.m.

Area	sq. ins. / sq. c.m.	55·48	8·6	80	12·4	101·28	15·7	120	18·6	136·77	21·2
Thickness	ins. / m.m.	12·7	1/2"	19	3/4	25·4	1	31·7	1 1/4	38·1	1 1/2
Length.		Safe Load.		Safe Load.		Safe Load.		Safe Load		Safe Load	
Metres.	Feet.	Kgs.	lbs.	Kgs.	lbs.	Kgs.	lbs.	Kgs.	lbs.	Kgs.	lbs.
2	6·561	32·1	70·7	46·2	102·0	58·5	129·1	69·4	152·9	79·1	174·3
2·5	8·202	29·2	64·4	42·1	92·8	53·3	117·5	63·1	139·2	72·0	158·6
3	9·842	26·4	58·1	38·0	83·8	48·1	106·1	57·0	125·7	65·0	143·2
3·5	11·483	23·6	52·0	34·0	74·9	43·0	94·9	51·0	112·4	58·1	128·1
4	13·123	21·0	46·2	30·2	66·6	38·3	84·3	45·3	99·9	51·7	113·9
4·5	14·764	18·7	41·1	26·9	59·3	34·1	75·1	40·4	89·0	46·0	101·4
5	16·404	16·6	36·7	24·0	52·9	30·4	66·9	36·0	79·3	41·0	90·4

7" Outside diam. of Column. 177·7 m.m.

Area	sq. ins. / sq. c.m.	94·8	14·7	108·3	16·8	121·9	18·9	145·1	22·5	166·8	25·9
Thickness	ins. / m.m.	19	3/4	22·2	7/8	25·4	1	31·7	1 1/4	38·1	1 1/2
Length.		Safe Load		Safe Load		Safe Load.		Safe Load		Safe Load	
Metres.	Feet.	Kgs.	lbs.	Kgs.	lbs.	Kgs.	lbs.	Kgs.	lbs.	Kgs.	lbs.
2·5	8·202	53·4	117·8	61·1	134·6	68·7	151·4	81·8	180·3	94·1	207·5
3	9·842	49·1	108·3	56·1	123·8	63·2	139·3	75·2	165·8	86·6	190·8
3·5	11·483	44·9	99·0	51·3	113·1	57·7	127·3	68·7	151·5	79·1	174·4
4	13·123	40·8	90·0	46·6	102·9	52·5	115·7	62·5	137·8	71·9	158·6
4·5	14·764	37·0	81·7	42·3	93·3	47·6	105·0	56·7	125·0	65·0	143·9
5	16·404	33·5	74·1	38·3	84·5	43·1	95·1	51·3	113·1	59·3	130·8
5·5	18·044	30·4	67·0	34·7	76·6	39·1	86·2	46·5	102·6	53·6	118·1

Table No. 23.

Safe Loads in Thousands of Kilograms and Pounds for Square Cast Iron Columns.

Allowed stresses in lbs. per sq. inch $\left\{ \dfrac{10000}{1+\dfrac{3\ L^2}{3200\ S^2}} \right.$
Factor of Safety 8.

L = length in inches.
S = width of side in inches.

Allowed stresses in Kilos. per sq. c.m. $\left\{ \dfrac{703}{1+\dfrac{3\ L^2}{3200\ S^2}} \right.$
Factor of Safety 8.

L = length in metres.
S = width of side in metres.

14″ □ Outside 355.6 m.m.

Area sq cm / sq ins		335.5	52	411.3	63.75	483.9	75	553.2	85.75	619.4	96
Thickness m.m / ins		25.4	1	31.7	1¼	38.1	1½	44.4	1¾	50.8	2
Length		Safe Load		Safe Load		Safe Load		Safe Load		Safe Load	
Metres	Feet	Kgs	lbs	Kgs	lbs.	Kgs	lbs.	Kgs	lbs.	Kgs.	lbs.
4	13.123	211	465	285	570	304	671	348	767	389	858
4.5	14.764	205	452	251	554	296	652	338	746	379	835
5	16.404	199	439	244	538	287	633	328	724	367	810
5.5	18.044	193	425	236	521	278	613	318	701	356	784
6	19.685	186	411	228	503	269	592	307	677	344	758
6.5	21.325	180	396	220	486	259	571	296	653	332	731
7	22.966	173	382	212	468	250	550	285	629	319	704
7.5	24.606	167	367	204	450	240	529	275	605	307	678
8	26.247	160	353	196	432	231	509	264	582	295	651
8.5	27.887	154	339	188	414	222	488	253	559	284	625

15″ □ Outside 381 m.m.

Area sq cm / sq ins		361.3	56	443.5	68.75	522.6	81	598.4	92.75	671	104
Thickness m.m / ins		25.4	1	31.7	1¼	38.1	1½	44.44	1¾	50.8	2
Length		Safe Load		Safe Load		Safe Load		Safe Load		Safe Load	
Metres	Feet	Kgs	lbs	Kgs	lbs	Kgs	lbs.	Kgs.	lbs	Kgs.	lbs.
4	13.123	230	508	283	623	333	734	381	841	428	943
4.5	14.764	225	495	276	608	325	716	372	820	417	920
5	16.404	219	482	269	592	316	697	362	799	406	896
5.5	18.044	213	469	261	575	307	678	352	776	395	870
6	19.685	206	454	253	558	298	657	341	753	383	844
6.5	21.325	200	440	245	540	289	636	331	729	369	813
7	22.966	193	426	237	522	279	615	320	705	359	790
7.5	24.606	186	411	229	504	270	594	309	680	346	763
8	26.247	180	396	221	486	260	573	298	656	334	736
8.5	27.887	173	382	213	469	251	552	287	633	322	709
9	29.528	167	368	205	451	241	532	276	609	310	683

Table No. 24.

Safe Loads in Thousands of Kilograms and Pounds
for
Square Cast Iron Columns.

Allowed stresses in lbs. per sq. inch. $\left\{ \dfrac{10000}{1+\dfrac{3\,L^2}{3200\,S^2}} \right.$
Factor of Safety 8.

L = length in inches.
S = width of side in inches.

Allowed stresses in Kilos per sq. c. m. $\left\{ \dfrac{703}{1+\dfrac{3\,L^2}{3200\,S^2}} \right.$
Factor of Safety 8.

L = length in metres.
S = width of side in metres.

12″ □ Outside 304 m.m.

Area	sq. ins. / sq. c. m.	217·7	33·75	283·8	44	346·7	53·75	406·4	63	462·9	71·75	516·1	80
Thickness	ins. / m. m.	19	¾	25·4	1	31·7	1¼	38·1	1½	44·4	1¾	50·8	2
Length		Safe Load		Safe Load		Safe Load		Safe Load		Safe Load		Safe Load	
Metres	Feet	Kgs.	lbs.	Kgs.	lbs.	Kgs.	lbs.	Kgs.	lbs.	Kgs.	lbs.	Kgs.	lbs.
3·5	11·483	136	300	178	392	217	478	254	561	290	639	323	712
4	13·123	132	291	172	379	210	463	246	543	280	618	312	689
4·5	14·764	127	280	166	365	203	446	237	523	270	596	301	665
5	16·404	122	270	159	351	195	429	228	503	260	573	290	639
5·5	18·044	117	259	153	337	187	412	219	483	250	550	278	613
6	19·685	112	248	146	323	179	394	210	462	239	526	266	587
6·5	21·325	107	337	140	309	171	377	200	442	228	503	254	561
7	22·966	102	226	134	294	163	360	191	422	218	480	243	535
7·5	24·606	98	215	127	281	155	343	182	402	208	458	231	510
8	26·247	93	205	121	267	148	327	174	383	198	436	220	487

13″ □ Outside 330·2 m.m.

Area	sq. ins. / sq. c. m.	309·7	48	379	58·75	445·1	69	508·1	78·75	567·7	88	624·2	96·75
Thickness	ins. / m. m.	25·4	1	31·75	1¼	38·1	1½	44·4	1¾	50·8	2	57·1	2¼
Length		Safe Load		Safe Load		Safe Load		Safe Load		Safe Load		Safe Load	
Metres	Feet	Kgs.	lbs.	Kgs.	lbs.	Kgs.	lbs.	Kgs.	lbs.	Kgs.	lbs.	Kgs.	lbs.
4	13·123	191	422	234	517	275	607	314	692	351	774	386	851
4·5	14·764	185	409	227	500	267	588	304	671	340	750	374	824
5	16·404	179	395	219	484	258	568	294	648	329	724	361	797
5·5	18·044	173	381	212	466	248	548	284	625	317	698	348	768
6	19·685	166	367	204	449	239	527	273	601	305	672	335	739
6·5	21·325	160	352	196	431	230	506	262	578	293	646	325	710
7	22·966	153	338	188	413	220	486	251	554	281	613	309	681
7·5	24·606	147	324	180	396	211	465	241	531	269	593	295	651
8	26·247	141	310	172	379	202	445	230	508	258	568	285	628
8·5	27·887	134	296	164	362	193	425	220	486	246	543	271	597

Table No. 25.

Safe Loads in Thousands of Kilograms and Pounds
for
Square Cast Iron Columns.

Allowed stresses in lbs per sq inch $\left\{ \frac{10000}{1+\frac{3\,L^2}{3200\,S^2}} \right.$
Factor of Safety 8.

L = length in inches.
S = width of side in inches.

Allowed stresses in Kilos per sq c.m. $\left\{ \frac{703}{1+\frac{3\,L^2}{3200\,S^2}} \right.$
Factor of Safety 8.

L = length in metres.
S = width of side in metres.

10″ □ Outside 254 m.m.

Area	sq ins / sq c m	179	27·75	232·2	36	282·26	43·75	329	51	372·58	57·75	412·9	64
Thickness	ins / m m	19	¾	25·4	1	31·7	1¼	38·1	1½	44·4	1¾	50·8	2
Length.		Safe	Load	Safe	Load	Safe	Load	Safe	Load	Safe	Load	Safe	Load
Metres	Feet	Kgs	lbs	Kgs	lbs	Kgs	lbs.	Kgs.	lbs.	Kgs.	lbs	Kgs.	lbs.
3·5	11·843	107	236	139	306	169	371	196	433	222	490	246	543
4	13·123	102	225	133	292	161	355	188	414	213	469	236	519
4·5	14·764	97	214	126	278	153	338	179	394	202	446	224	495
5	16·404	92	204	120	264	146	321	170	374	192	424	213	470
5·5	18·044	87	193	113	250	138	304	161	354	182	401	202	444
6	19·685	83	182	107	237	130	287	152	335	172	379	191	420
6·5	21·325	78	172	101	223	123	271	143	316	162	358	180	396
7	22·966	73	162	95	210	116	256	135	298	153	337	170	374
7·5	24·606	69	153	90	198	109	241	127	281	144	318	160	352
8	26·247	65	144	85	187	103	227	120	264	136	299	150	332

11″ □ Outside 279·4 m.m.

Area.	sq ins / sq c m	198·4	30·75	258·1	40	314·5	48·75	367·7	57	417·7	64·75	464·5	72
Thickness	ins. / m m.	19	¾	25·4	1	31·7	1¼	38·1	1½	44·4	1¾	50·8	2
Length.		Safe	Load	Safe	Load	Safe	Load	Safe	Load	Safe	Load	Safe	Load
Metres.	Feet.	Kgs	lbs.	Kgs	lbs.	Kgs.	lbs.	Kgs	lbs.	Kgs	lbs	Kgs.	lbs.
3·5	11·843	122	268	158	349	193	425	225	497	256	565	285	628
4	13·123	117	258	152	336	185	409	217	478	246	543	274	604
4·5	14·764	112	247	146	322	178	392	208	459	236	521	263	579
5	16·404	107	237	140	308	170	375	199	438	226	498	251	554
5·5	18·044	102	226	133	293	162	358	190	418	216	475	239	528
6	19·685	97	215	127	279	154	340	180	398	205	452	228	503
6·5	21·325	93	204	120	265	147	323	171	378	195	429	217	477
7	22·966	88	194	114	252	139	307	163	359	185	408	206	453
7·5	24·606	83	184	108	239	132	291	154	340	175	387	195	430
8	26·247	79	174	103	226	125	276	146	323	166	367	185	407
8·5	27·887	75	165	98	214	118	261	139	305	157	347	175	386

Table No. 26.

Safe Loads in Thousands of Kilograms and Pounds for Square Cast Iron Columns.

Allowed stresses in lbs per sq inch. $\left\{ \dfrac{10000}{1+\dfrac{3\,L^2}{3200\,S^2}} \right.$
Factor of Safety 8.

L = length in inches
S = width of side in inches.

Allowed stresses in Kilos per sq c.m $\left\{ \dfrac{703}{1+\dfrac{3\,L^2}{3200\,S^2}} \right.$
Factor of Safety 8.

L = length in metres.
S = width of side in metres.

8″ □ Outside 203 m.m.

Area sq ins / sq cm		14.03	21.75	18.06	28	21.77	33.75	25.16	39	28.23	43.75	30.97	48
Thickness ins / m.m		19	3/4	25.4	1	31.7	1¼	38.1	1½	44.4	1¾	50.8	2
Length		Safe Load		Safe Load		Safe Load		Safe Load		Safe Load		Safe Load	
Metres	Feet	Kgs	lbs	Kgs	lbs	Kgs	lbs	Kgs	lbs	Kgs	lbs	Kgs	lbs
2.5	8.202	86	190	111	245	134	296	155	341	174	383	191	420
3	9.842	82	181	105	232	127	280	147	324	165	363	181	398
3.5	11.483	77	170	99	219	120	264	139	305	155	343	171	376
4	13.123	72	159	93	205	112	247	130	286	146	321	160	352
4.5	14.764	68	149	87	192	105	232	121	268	136	300	149	330
5	16.404	63	139	81	179	98	215	113	249	127	279	139	306
5.5	18.044	58	129	75	166	91	200	105	231	118	259	129	284
6	19.685	54	120	70	154	84	186	97	215	109	241	120	264

9″ □ Outside 228.6 m.m.

Area sq ins / sq cm		15.97	24.75	20.64	32	25.0	38.75	29.03	45	32.74	50.75	36.13	56
Thickness ins / m.m		19	3/4	25.4	1	31.7	1¼	38.1	1½	44.4	1¾	50.8	2
Length		Safe Load		Safe Load		Safe Load		Safe Load		Safe Load		Safe Load	
Metres	Feet	Kgs	lbs	Kgs	lbs	Kgs	lbs	Kgs	lbs	Kgs	lbs	Kgs	lbs
3	9.842	97	213	125	276	151	334	176	388	198	437	219	482
3.5	11.483	92	203	119	263	144	318	168	370	189	417	209	460
4	13.123	87	192	113	249	137	301	159	350	179	394	197	435
4.5	14.764	82	181	106	235	129	284	150	330	169	372	186	411
5	16.404	78	171	100	221	122	268	141	311	159	351	176	387
5.5	18.044	73	161	94	208	114	252	132	292	149	330	165	364
6	19.685	68	151	88	195	107	236	124	274	140	309	154	341
6.5	21.325	64	141	83	182	100	221	116	256	131	289	145	319
7	22.966	60	132	77	170	94	206	109	240	123	279	135	298
7.5	24.606	56	124	72	160	88	194	102	225	115	254	127	280

Table No. 27.

Safe Loads in Thousands of Kilograms and Pounds
for
Square Cast Iron Columns.

Allowed stresses in lbs per sq inch, Factor of Safety 8: $\dfrac{10000}{1+\dfrac{3l^2}{3200s^2}}$

s = Width of side in inches
l = length in inches

Allowed stresses in Kilos per sq. c.m, Factor of Safety 8: $\dfrac{703}{1+\dfrac{3l^2}{3200s^2}}$

s = Width of side in metres
l = length in metres

6" □ Outside 152.4 m.m.

Area	sq ins. / sq c.m.	71.	11.	101.6	15.75	129	20.	153.2	23.75	174.2	27.
Thickness	ins. / m.m.	12.7	½"	19.1	¾"	25.4	1"	31.7	1¼"	38.1	1½"
Length.		Safe Load		Safe Load		Safe Load		Safe Load		Safe Load	
Metres.	Feet	Kgs	lbs.	Kgs	lbs.	Kgs	lbs.	Kgs	lbs.	Kgs	lbs.
2	6.561	43.0	94.8	61.5	135.7	78.1	172.3	92.8	204.6	105.5	232.6
2.5	8.202	39.8	87.8	57.0	125.7	72.4	159.7	86.0	189.6	97.8	215.6
3	9.842	36.7	80.9	52.5	115.8	66.7	147.0	79.2	174.6	90.0	198.5
3.5	11.483	33.4	73.7	47.9	105.6	60.8	134.0	72.2	159.2	82.1	181.0
4	13.123	30.3	66.9	43.5	95.8	55.2	121.7	65.5	144.5	74.5	164.2
4.5	14.764	27.5	60.6	39.3	86.7	49.9	110.1	59.3	130.7	67.4	148.6
5	16.404	24.8	54.7	35.6	78.4	45.2	99.5	53.6	118.2	61.0	134.4

7" □ Outside 177.7 m.m.

Area.	sq ins. / sq c.m.	121.	18.75	138.1	21.4	154.8	24.	185.5	28.75	212.9	33.
Thickness.	ins / m m	19.1	¾"	22.2	⅞"	25.4	1"	31.7	1¼"	38.1	1½"
Length.		Safe Load		Safe Load		Safe Load		Safe Load		Safe Load	
Metres.	Feet	Kgs.	lbs	Kgs	lbs.	Kgs.	lbs.	Kgs.	lbs.	Kgs.	lbs.
2.5	8.202	71.7	158.0	81.8	180.4	91.8	202.3	109.9	242.3	126.2	278.1
3	9.842	67.1	147.9	76.5	168.8	85.8	189.3	102.8	226.7	118.0	260.2
3.5	11.483	62.3	137.5	71.2	156.9	79.8	175.9	95.6	210.8	109.7	241.9
4	13.123	57.7	127.1	65.8	145.1	73.8	162.7	88.4	194.9	101.5	223.7
4.5	14.764	53.2	117.2	60.7	133.7	68.0	150.0	81.5	179.7	93.6	206.2
5	16.404	48.8	107.7	55.7	122.9	62.5	137.9	74.9	165.1	86.0	189.6
5.5	18.044	44.9	99.0	51.2	112.9	57.4	126.6	68.8	151.7	79.0	174.1

EXPLANATION OF TABLES OF STRENGTH OF STEEL AND IRON SECTIONS, AS USED FOR BUILDING CONSTRUCTION.

Tables Nos. 1, 2, 3, 4 and 5 give the loads which standard steel beams will safely carry. That is when the load is uniformly distributed over the length of the beam, the span meaning the distance between the points of support. These loads include the weight of the beam which therefore must be deducted in order to arrive at the net load which the beam will carry. If the load is concentrated at the centre of the beam take half the load as given in the tables. It is not desirable to use beams of a greater span than the span given in these tables when the under side of the beam is to be plastered, because the deflection of the beam would tend to crack the plaster. Inasmuch as the carrying capacity of beams increases largely with their depth, it is economical to use the greatest depth of beam consistent with the other conditions to which it is necessary to conform; that is equal height, etc.

Tables Nos. 6, 7, 8, 9, 10, 11, 12 and 13 give the safe loads for Phœnix columns of the sections and lengths given. It is not desirable to use columns of a greater length than that given in the table, unless the shaft of the column is supported sideways (so that it will not bend) at points not further apart than the length given in the tables. For loads which are greater than those given in the tables it is desirable to construct the column using filler bars between the segments to increase the area of the column by the amount of metal required to carry the load.

Tables Nos. 14, 15, 16 and 17 give the safe carrying capacity of Zee bar columns. The same explanation as given above for Phœnix columns holds good for this class of material.

Tables Nos. 18 to 27 inclusive, give the safe carrying capacity of cast iron columns. It is not desirable to use columns of greater length than those specified in these tables because in some cases it would be impossible to cast them.

STANDARD SPECIFICATION OF QUALITY AND FINISH FOR ROLLED STEEL AND CAST IRON AS USED IN BUILDING CONSTRUCTION.

RULES GOVERNING INSPECTION OF SAME.

No specific process or provision of manufacture will be demanded provided the material fulfills the requirements of this specification.

All rolled shapes and plates are to be of medium steel: rivets of rivet steel, and bolts and nuts may be of iron or steel.

STRUCTURAL STEEL.

Tensile strength, elastic limit and ductility shall be determined from samples cut from finished material, and the test pieces shall not be less than ½ square inch (3.22568 sq. centimetres) in sectional area and about 12 inches (30.479 centimetres) long.

All broken samples must show a uniform silky fracture of a steel grey color, free from lustre or black casts.

Slight variations in the shapes of the pieces from that shown on the drawing will be allowed to

accommodate the use of stock material, but in all such variations the area of cross-section of the pieces substituted shall be equal to or greater than that originally specified.

The variation in cross-section or weight of more than 2½ per cent. from that specified will be sufficient cause for rejection, except in the case of sheared plates, which will be covered by the following permissible variations.

Plates 12½ pounds (5.669 kilograms) per square foot or heavier, up to 100 inches (254 centimetres) wide, when specified to weight, shall not average more than 2½ per cent. variation above or 2½ per cent. below the theoretical weight. When 100 inches (254 centimetres) wide and over, 5 per cent. above or 5 per cent. below the theoretical weight.

Plates under 12½ pounds (5.669 kilograms) per square foot, when specified to weight, shall not average a greater variation than the following.

Up to 75 inches (190.5 centimetres) wide, 2½ per cent. above or 2½ per cent. below the theoretical weight. 75 inches (190.5 centimetres) wide up to 100 inches (254 centimetres) wide, 5 per cent above or 3 per cent. below the theoretical weight. When 100 inches (254 centimetres) wide and over, 10 per cent. above or 3 per cent. below the theoretical weight.

For all plates specified to gauge, there will be permitted an average excess of weight over that corresponding to the dimensions on the specification equal in amount to that specified in the following table.

ALLOWANCES FOR OVER-WEIGHT OF RECTANGULAR PLATES WHEN SPECIFIED TO GAUGE.

Plates ¼ inch (.635 centimetres) and over in thickness.

WIDTH OF PLATE.

Thickness of Plate In.	cm.	Up to 75" (190.5 cm.) Per cent.	75" to 100" (190.5 to 254 cm.) Per cent.	Over 100" to 115" (254 to 292.1 cm.) Per cent.	Over 115" (292.1 cm.) Per cent.
¼	.635	10	14	18	—
5/16	.793	8	12	16	—
3/8	.953	7	10	13	17
7/16	1.111	6	8	10	13
½	1.269	5	7	9	12
9/16	1.428	4½	6½	8½	11
5/8	1.587	4	6	8	10
Over 5/8	1.587	3½	5	6½	9

Plates under ¼ inch (.635 centimetres) thickness.

WIDTH OF PLATE.

Thickness of Plate. In.	cm.	Up to 50" (127 cm.) Per cent.	50" to 70" (127 to 177.8 cm.) Per cent.	Over 70" (177.8 cm.) Per cent.
⅛ up to)	.317			
5/32	.397	10	15	20
5/32 up to)	.397			
3/16	.476	8½	12½	17
3/16 up to)	.476			
¼	.635	7	10	15

The weight of one cubic in. (16. 387 cu. cm.) is assumed to be .2833 pounds (.1285 kilograms)

MEDIUM STEEL.

Medium steel shall have an ultimate strength when tested in samples in the dimensions above stated, of 60,000 pounds to 70,000 pounds per square inch (42184 kilos to 49212 kilos per 10 square cm.) an elastic limit of not less than one-half the ultimate strength. Percentage of elongation $\frac{1,400,000}{\text{ultimate strength}}$ in 8 inches (20.319 cm.) except for pin steel which shall have an elongation of 5 per cent. less.

RIVET STEEL.

Ultimate strength 48,000 to 58,000 pounds per square inch, (33747 to 40778 kilos per 10 square centimetres). Elastic limit not less than one-half the ultimate strength.

Percentage of elongation $\frac{1,400,000}{\text{ultimate strength}}$

Bending test, 180 degrees flat on itself, without fracture on outside of bent portion.

STRUCTURAL CAST IRON.

Quality.—All castings must be of the very best quality tough grey iron. Sample pieces 1 inch square (2.54 centimetres sq.) cast from the same heat of metal as used for the work, in sand moulds, are to be capable of sustaining on a clear span of 4 feet 6 inches (137.16 centimetres) a central load of 500 lbs. (226.80 kilograms) when tested in the rough bar.

Finish.—All castings must be true, smooth, straight, out of wind and of a uniform thickness, and must be entirely free from honeycombs, blow holes, cracks, cinders, seam marks or other defects. Cores for all

columns, 1 inch (2.5400 centimetres) thick or less, must be accurately spaced so that the metal in the shaft of the column will not vary more than 1/8 inch (.317 centimetres), in other words, if the metal on one side of a column shows a variation of more than 1/8 inch (.317 centimetres) thinner than called for on the drawings, although the opposite side of the shaft may show a thickness 1/8 inch (.317 centimetres) greater, it will be sufficient cause for rejection. For all columns thicker than 1 inch (2.5400 centimetres) the core must not shift over 3/16 inch, (.476 centimetres) as provided for above. All holes required to be cored must be carefully cored in their correct position. All holes required to be drilled must be drilled out of the solid metal as shown on the drawings. All columns and bases required to be faced, unless otherwise specified, must be faced at right angles to the axis of the shaft and the parts so faced must exhibit the full surface of metal. All faced surfaces must be coated with white lead and tallow immediately after facing.

Variation in Weight—After the castings have been carefully cleaned the same must be weighed and the shipping weight must be as close as possible to the figured weights. The following variations in weight will be allowed:

Lintels	2½%
Bases	3%
Columns 1 inch and over (2.54 cm. & over) in thickness	2½%
Columns ¾ inch thick and less than 1 inch (1.905 cm. and less than 2.54 cm.)	3%
Columns less than ¾ inch (1.905 cm.)	5%

The calculated weights are intended to cover all of the metal in the pieces including fillets and are based on one cubic foot of cast iron weighing 450 pounds (7208.65 kilos per cu. meter).

INSPECTION.

All facilities for the inspection of material and workmanship will be permitted to the owner or his representatives, without additional charge, but such inspection must, for the raw material, be performed at the rolling mills or foundries where the rolled steel or the castings are manufactured, and the inspection for workmanship must be performed at the shops before the material is shipped, and such inspection and acceptance must be final at these points.

For specification of quality and Workmanship Railway and Highway Bridges see pages 296 and 320.

Table No. 28.

Standard spacing and dimensions of rivet and bolt holes through flanges of I beams, channels and angles.

Standard I Beams

Depth m/m	Depth ins	Weight Kg. per m.	Weight lbs p.f.	a m/m	a ins	Dia. rivet or bolt. m/m	Dia. rivet or bolt. ins
609.58	24	119.05	80	101.59	4		
507.99	20	119.05	80	101.59	4		
507.99	20	96.73	65	101.59	4		
457.19	18	81.85	55	95.24	3¾	19.0	¾
380.99	15	119.05	80	95.24	3¾	to	to
380.99	15	89.29	60	95.24	3¾	22.2	⅞
380.99	15	62.50	42	88.89	3½		
304.79	12	59.52	40	76.19	3		
304.79	12	46.87	31½	76.19	3		
253.99	10	37.20	25	69.85	2¾	19.0	¾
228.59	9	31.25	21	63.49	2½	19.0	¾
203.19	8	26.78	18	57.14	2¼	19.0	¾
177.79	7	22.32	15	57.14	2¼	15.8	⅝
152.39	6	18.23	12¼	50.79	2	15.8	⅝
126.99	5	14.51	9¾	44.44	1¾	12.7	½
101.59	4	11.16	7½	38.09	1½	12.7	½
76.19	3	8.18	5½	31.74	1¼	12.7	½

Standard Channels

Depth m/m	Depth ins	Weight Kg. per m	Weight lbs p.f.	b m/m	b ins	Diam. rivet or bolt m/m	Diam. rivet or bolt ins
380.99	15	66.96	45	50.79	2	19.0	¾
380.99	15	49.11	33	50.79	2	19.0	¾
304.79	12	44.64	30	44.44	1¾	19.0	¾
304.79	12	30.50	20½	44.44	1¾	19.0	¾
253.99	10	37.20	25	44.44	1¾	19.0	¾
253.99	10	22.32	15	38.09	1½	19.0	¾
228.59	9	29.76	20	38.09	1½	19.0	¾
228.59	9	19.71	13¼	34.91	1⅜	19.0	¾
203.19	8	24.18	16¼	38.09	1½	19.0	¾
203.19	8	16.75	11¼	34.91	1⅜	19.0	¾
177.19	7	25.67	17¼	38.09	1½	15.8	⅝
177.19	7	14.50	9¾	31.74	1¼	15.8	⅝
152.39	6	19.34	13	31.74	1¼	15.8	⅝
152.39	6	11.90	8	28.56	1⅛	15.8	⅝
126.99	5	13.39	9	28.56	1⅛	12.7	½
126.99	5	9.67	6½	28.56	1⅛	12.7	½
101.59	4	7.81	5¼	25.39	1	12.7	½
76.19	3	5.96	4	22.22	⅞	12.7	½

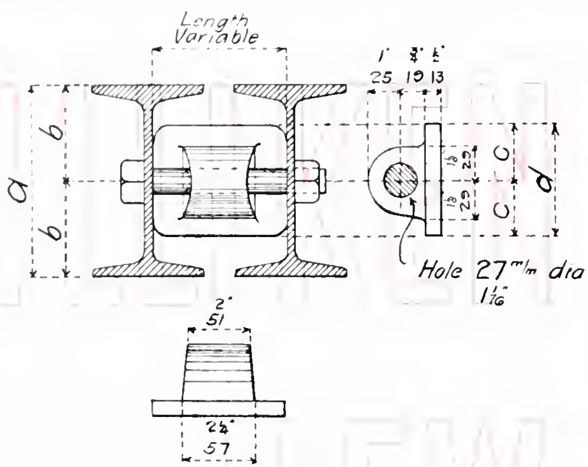
Standard Angles

Width of Leg m/m	Width of Leg ins.	c m/m	c ins	Diam. rivets or bolts m/m	Diam. rivets or bolts ins
177.79	7	101.59	4	22.2	⅞
152.39	6	88.89	3½	22.2	⅞
126.99	5	76.19	3	22.2	⅞
101.59	4	63.49	2½	22.2	⅞
88.89	3½	50.79	2	22.2	⅞
76.19	3	44.44	1¾	22.2	⅞
63.49	2½	38.09	1½	19.0	¾
57.14	2¼	31.74	1¼	15.8	⅝
50.79	2	28.56	1⅛	15.8	⅝
44.44	1¾	25.4	1	12.7	½
38.09	1½	22.22	⅞	9.5	⅜
31.74	1¼	19.0	¾	9.5	⅜
25.4	1	14.28	9/16	6.3	¼

Width of leg m/m	Width of leg ins	d m/m	d ins	e m/m	e ins	Dia. rivet or bolt m/m	Dia. rivet or bolt ins
177.79	7	63.49	2½	76.19	3	22.2	⅞
152.39	6	63.49	2½	57.14	2¼	22.2	⅞
126.99	5	50.79	2	44.44	1¾	22.2	⅞

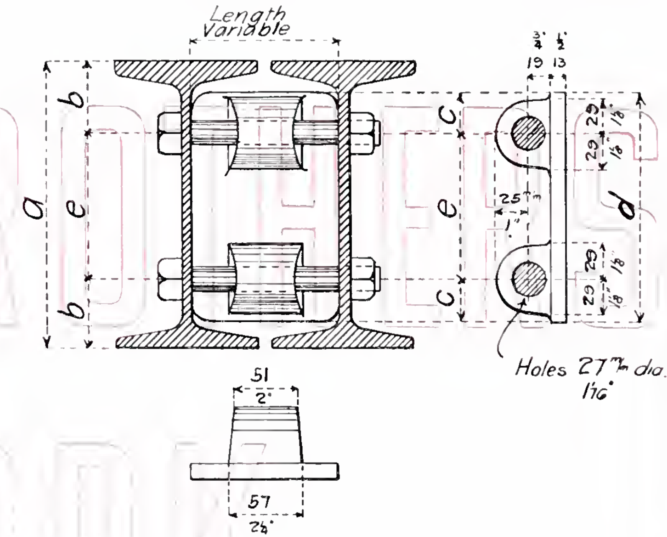
Table No. 29.

Standard Cast Separators for Beam Girders.



Mark	a		b		c		d	
	m/m	ins	m/m	ins	m/m	ins	m/m	ins
No 5	126.99	5	63.5	2½	44.4	1¾	88.9	3½
No 6	152.39	6	76.2	3	50.8	2	101.6	4
No 7	177.79	7	88.9	3½	63.5	2½	127.0	5
No 8	203.19	8	101.6	4	76.2	3	152.4	6

All dimensions are given in millimetres and inches

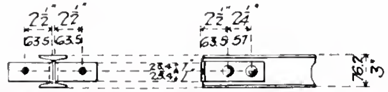


Mark	a		b		c		d		e	
	m/m	ins	m/m	ins	m/m	ins	m/m	ins	m/m	ins
No 9	228.59	9	57.1	2¼	29.0	1⅛	171.4	6¾	114.3	4½
No 10	253.99	10	63.5	2½	29.0	1⅛	184.1	7¼	126.9	5
No 12	304.79	12	88.9	3½	50.8	2	228.6	9	126.9	5
No 15	380.99	15	95.2	3¾	57.1	2¼	304.8	12	190.6	7½
No 20	507.99	20	101.6	4	50.8	2	406.4	16	304.8	12
No 24	609.58	24	114.3	4½	63.5	2½	508.0	20	381.0	15
No 18	457.19	18	76.2	3	31.7	1¼	368.3	14½	304.8	12

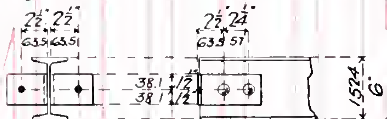
All dimensions are given in millimetres and inches.

Standard Beam Connections.

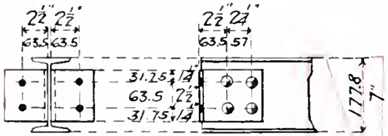
All dimensions are given in millimetres and inches.
All rivets are 19 millimetres ($\frac{3}{4}$") diameter.
All holes are 20.6 millimetres ($\frac{13}{16}$") diameter.



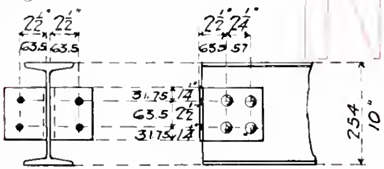
2 Angles 152.4 × 101.6 × 9.5 - 50.8 long.
2 " 6" × 4" × $\frac{3}{8}$" 2" "
Weight 1 Pair Brackets & Bolts 5.33 lbs.



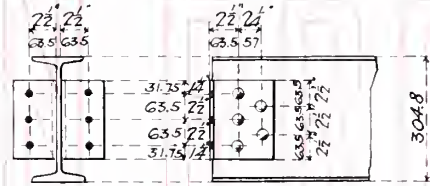
2 Angles 152.4 × 101.6 × 9.5 - 76.2 long.
2 " 6" × 4" × $\frac{3}{8}$" 3" "
Weight 1 Pair Brackets & Bolts 7 lbs.



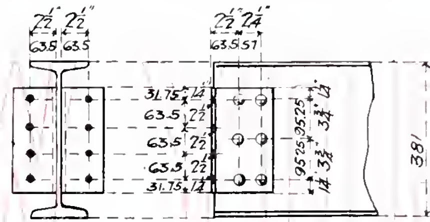
2 Angles 152.4 × 101.6 × 9.5 - 127 long.
2 " 6" × 4" × $\frac{3}{8}$" 5" "
Weight 1 Pair Brackets & Bolts 12.3 lbs.



2 Angles 152.4 × 101.6 × 9.5 - 127 long.
2 " 6" × 4" × $\frac{3}{8}$" 5" "
Weight 1 Pair Brackets & Bolts 12.3 lbs.

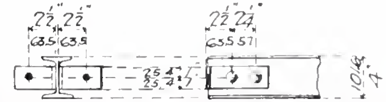


2 Angles 152.4 × 101.6 × 9.5 - 190.5 long.
2 " 6" × 4" × $\frac{3}{8}$" $7\frac{1}{2}$" "
Weight 1 Pair Brackets & Bolts 17.5 lbs.

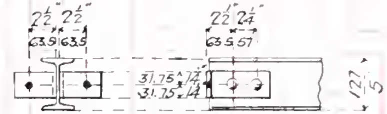


2 Angles 152.4 × 101.6 × 9.5 - 254 long.
2 " 6" × 4" × $\frac{3}{8}$" 10" "
Weight 1 Pair Brackets & Bolts 23.6 lbs.

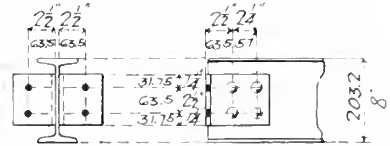
Connections for 457.19 (18"), 507.99 (20"), 609.59 (24") m/m beams should be designed for the load that the beam is intended to carry.



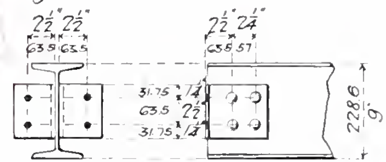
2 Angles 152.4 × 101.6 × 9.5 - 50.8 long.
2 " 6" × 4" × $\frac{3}{8}$" 2" "
Weight 1 Pair Brackets & Bolts 5.33 lbs.



2 Angles 152.4 × 101.6 × 9.5 - 63.5 long.
2 " 6" × 4" × $\frac{3}{8}$" $2\frac{1}{2}$" "
Weight 1 Pair Brackets & Bolts 6.1 lbs.



2 Angles 152.4 × 101.6 × 9.5 - 127 long.
2 " 6" × 4" × $\frac{3}{8}$" 5" "
Weight 1 Pair Brackets & Bolts 12.3 lbs.



2 Angles 152.4 × 101.6 × 9.5 - 127 long.
2 " 6" × 4" × $\frac{3}{8}$" 5" "
Weight 1 Pair Brackets & Bolts 12.3 lbs.

Table No. 31.

Sections of Rivetted Columns.

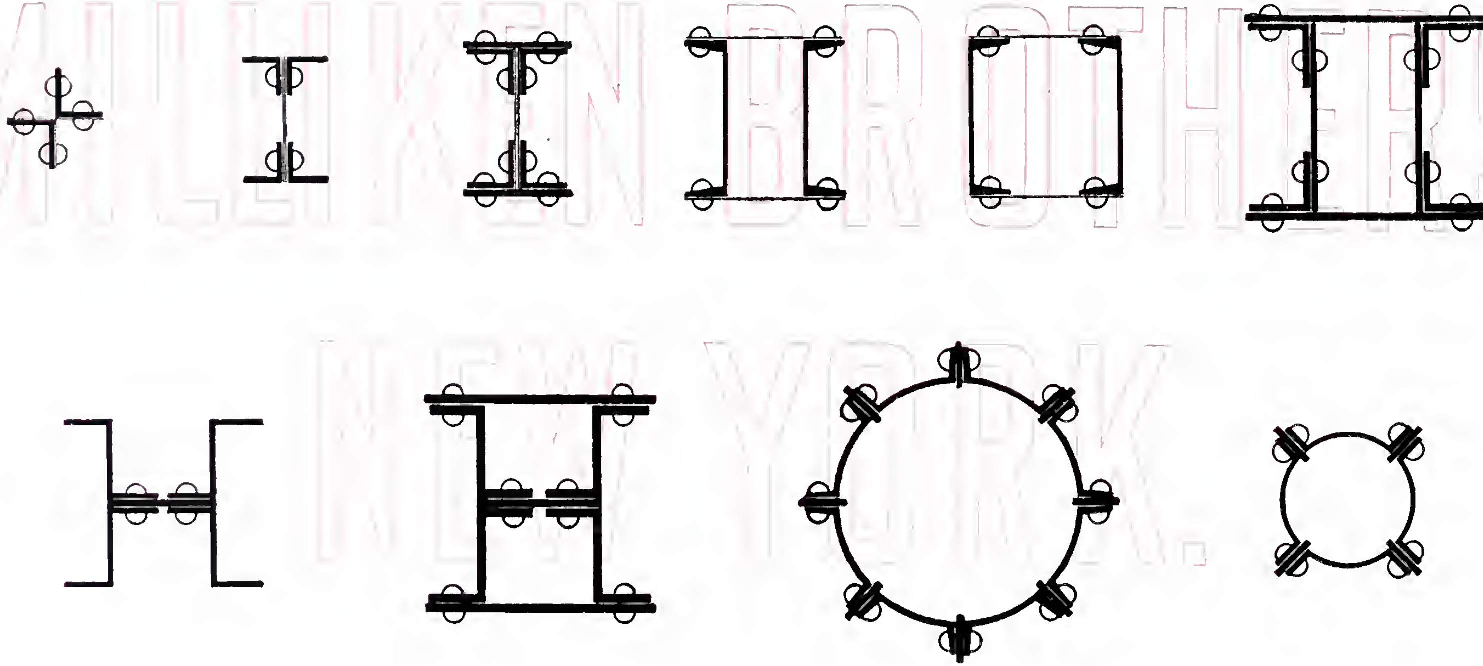


Table of meters equivalent to feet.

feet.	0	1	2	3	4	5	6	7	8	9
0		·30479	·6095	·9143	1·2191	1·5239	1·8287	2·1335	2·4383	2·7431
10	3·047945	3·35274	3·6575	3·9623	4·2671	4·5719	4·8767	5·1815	5·4863	5·7911
20	6·095890	6·40068	6·7054	7·0102	7·3150	7·6198	7·9246	8·2294	8·5342	8·8390
30	9·143835	9·44863	9·7534	10·0582	10·3630	10·6678	10·9726	11·2774	11·5822	11·8870
40	12·19178	12·4966	12·8014	13·1062	13·4110	13·7158	14·0205	14·3253	14·6301	14·9349
50	15·23972	15·5445	15·8493	16·1541	16·4589	16·7637	17·0685	17·3733	17·6781	17·9829
60	18·28767	18·5925	18·8973	19·2020	19·5068	19·8116	20·1164	20·4212	20·7260	21·0308
70	21·33561	21·6404	21·9452	22·2500	22·5548	22·8596	23·1644	23·4692	23·7740	24·0788
80	24·38356	24·6884	24·9931	25·2979	25·6027	25·9075	26·2123	26·5171	26·8219	27·1267
90	27·43150	27·7363	28·0411	28·3459	28·6507	28·9555	29·2603	29·5651	29·8699	30·1747

Table of feet equivalent to meters.

meters	0	1	2	3	4	5	6	7	8	9
0		3·2809	6·5618	9·8427	13·1236	16·4045	19·6854	22·9663	26·2472	29·5281
10	32·8089	36·0899	39·3708	42·6517	45·9326	49·2135	52·4944	55·7753	59·0562	62·3371
20	65·6179	68·8989	72·1798	75·4607	78·7416	82·0225	85·3034	88·5843	91·8652	95·1461
30	98·4269	101·708	104·989	108·270	111·551	114·831	118·112	121·393	124·674	127·955
40	131·2360	134·517	137·798	141·079	144·360	147·640	150·921	154·202	157·483	160·764
50	164·0450	167·326	170·607	173·888	177·169	180·449	183·730	187·011	190·292	193·573
60	196·8540	200·135	203·416	206·697	209·978	213·258	216·539	219·820	223·101	226·382
70	229·6629	232·944	236·225	239·506	242·787	246·067	249·348	252·629	255·910	259·191
80	262·4719	265·753	269·034	272·315	275·596	278·876	282·157	285·438	288·719	292·000
90	295·2809	298·562	301·843	305·124	308·405	311·685	314·966	318·247	321·528	324·809

Table No. 33.

Table of Meters equivalent to each $\frac{1}{100}$ of an inch.

Inches	0	1	2	3	4	5	6	7	8	9	10	11
·0.		·025400	·050799	·076199	·101598	·126998	·152397	·177797	·203196	·228596	·253995	·279395
·01	·000254	·025654	·051053	·076453	·101852	·127252	·152651	·178051	·203450	·228850	·254249	·279649
·02	·000508	·025908	·051307	·076707	·102106	·127506	·152905	·178305	·203704	·229104	·254503	·279903
·03	·000762	·026162	·051561	·076961	·102360	·127760	·153159	·178559	·203958	·229358	·254757	·280157
·04	·001015	·026415	·051814	·077214	·102613	·128013	·153412	·178812	·204211	·229611	·255010	·280410
·05	·001269	·026669	·052068	·077468	·102867	·128267	·153666	·179066	·204465	·229865	·255264	·280664
·06	·001523	·026923	·052322	·077722	·103121	·128521	·153920	·179320	·204719	·230119	·255518	·280918
·07	·001777	·027177	·052576	·077976	·103375	·128775	·154174	·179574	·204973	·230373	·255772	·281172
·08	·002031	·027431	·052830	·078230	·103629	·129029	·154428	·179828	·205227	·230627	·256026	·281426
·09	·002285	·027685	·053084	·078484	·103883	·129283	·154683	·180082	·205481	·230881	·256280	·281680
·10	·002539	·027939	·053339	·078738	·104137	·129538	·154936	·180336	·205735	·231135	·256534	·281934
·11	·002793	·028193	·053592	·078992	·104391	·129791	·155190	·180590	·205989	·231389	·256788	·282188
·12	·003047	·028447	·053846	·079246	·104645	·130045	·155444	·180844	·206243	·231643	·257042	·282442
·13	·003301	·028701	·054100	·079500	·104899	·130299	·155698	·181098	·206497	·231897	·257296	·282696
·14	·003555	·028955	·054354	·079754	·105153	·130553	·155952	·181352	·206751	·232151	·257550	·282950
·15	·003809	·029209	·054608	·080008	·105407	·130807	·156206	·181606	·207005	·232405	·257804	·283204
·16	·004063	·029463	·054862	·080262	·105661	·131061	·156460	·181860	·207259	·232659	·258058	·283458
·17	·004317	·029717	·055116	·080516	·105915	·131315	·156714	·182114	·207513	·232913	·258312	·283712
·18	·004571	·029971	·055370	·080770	·106169	·131569	·156968	·182368	·207767	·233167	·258566	·283966
·19	·004825	·030225	·055624	·081024	·106423	·131823	·157222	·182622	·208021	·233421	·258820	·284220
·20	·005079	·030479	·055879	·081278	·106677	·132078	·157476	·182876	·208275	·233675	·259074	·284474
·21	·005333	·030733	·056132	·081532	·106931	·132331	·157730	·183130	·208529	·233929	·259328	·284728
·22	·005587	·030987	·056386	·081786	·107185	·132585	·157984	·183384	·208783	·234183	·259582	·284982
·23	·005841	·031241	·056640	·082040	·107439	·132839	·158238	·183638	·209037	·234437	·259836	·285236
·24	·006095	·031495	·056894	·082294	·107693	·133093	·158492	·183892	·209291	·234691	·260090	·285490
·25	·006349	·031749	·057148	·082548	·107947	·133347	·158746	·184146	·209545	·234945	·260344	·285744
·26	·006603	·032003	·057402	·082802	·108201	·133601	·159000	·184400	·209799	·235199	·260598	·285998
·27	·006857	·032257	·057656	·083056	·108455	·133855	·159254	·184654	·210053	·235453	·260852	·286252
·28	·007111	·032511	·057910	·083310	·108709	·134109	·159508	·184908	·210307	·235707	·261106	·286506
·29	·007365	·032765	·058164	·083564	·108963	·134363	·159762	·185162	·210561	·235961	·261360	·286760
·30	·007619	·033019	·058418	·083818	·109217	·134618	·160016	·185416	·210815	·236215	·261614	·287014
·31	·007873	·033273	·058672	·084072	·109471	·134871	·160270	·185670	·211069	·236469	·261868	·287268
·32	·008127	·033527	·058926	·084326	·109725	·135125	·160524	·185924	·211323	·236723	·262122	·287522

12 inches = 1 foot = ·304794 metres

Table No. 34.

Table of Meters equivalent to each $\frac{1}{100}$ of an inch.

Inches	0	1	2	3	4	5	6	7	8	9	10	11
·33	·008381	·033781	·059180	·084580	·109979	·135379	·160778	·186178	·211577	·236977	·262376	·287776
·34	·008635	·034035	·059434	·084834	·110233	·135633	·161032	·186432	·211831	·237231	·262630	·288030
·35	·008889	·034289	·059688	·085088	·110487	·135887	·161286	·186686	·212085	·237485	·262884	·288284
·36	·009143	·034543	·059942	·085342	·110741	·136141	·161540	·186940	·212339	·237739	·263138	·288538
·37	·009397	·034797	·060196	·085596	·110995	·136395	·161794	·187194	·212593	·237993	·263392	·288792
·38	·009651	·035051	·060450	·085850	·111249	·136649	·162048	·187448	·212847	·238247	·263646	·289046
·39	·009905	·035305	·060704	·086104	·111503	·136903	·162302	·187702	·213101	·238501	·263900	·289300
·40	·010159	·035559	·060958	·086358	·111757	·137157	·162556	·187956	·213355	·238755	·264154	·289554
·41	·010413	·035813	·061212	·086612	·112011	·137411	·162810	·188210	·213609	·239009	·264408	·289808
·42	·010667	·036067	·061466	·086866	·112265	·137665	·163064	·188464	·213863	·239263	·264662	·290062
·43	·010921	·036321	·061720	·087120	·112519	·137919	·163318	·188718	·214117	·239517	·264916	·290316
·44	·011175	·036575	·061974	·087374	·112773	·138173	·163572	·188972	·214371	·239771	·265170	·290570
·45	·011429	·036829	·062228	·087628	·113027	·138427	·163826	·189226	·214625	·240025	·265424	·290824
·46	·011683	·037083	·062482	·087882	·113281	·138681	·164080	·189480	·214879	·240279	·265678	·291078
·47	·011937	·037337	·062736	·088136	·113535	·138935	·164334	·189734	·215138	·240533	·265932	·291332
·48	·012191	·037591	·062990	·088390	·113789	·139189	·164588	·189988	·215387	·240787	·266186	·291586
·49	·012445	·037845	·063244	·088644	·114043	·139443	·164842	·190242	·215641	·241041	·266440	·291840
·50	·012699	·038099	·063498	·088898	·114297	·139697	·165096	·190496	·215895	·241295	·266694	·292094
·51	·012953	·038353	·063752	·089152	·114551	·139951	·165350	·190750	·216149	·241549	·266948	·292348
·52	·013207	·038607	·064006	·089406	·114805	·140205	·165604	·191004	·216403	·241803	·267202	·292602
·53	·013461	·038861	·064260	·089660	·115059	·140459	·165858	·191258	·216657	·242057	·267456	·292856
·54	·013715	·039115	·064514	·089914	·115313	·140713	·166112	·191512	·216911	·242311	·267710	·293110
·55	·013969	·039369	·064768	·090168	·115567	·140967	·166366	·191766	·217165	·242565	·267964	·293364
·56	·014223	·039623	·065022	·090422	·115821	·141221	·166620	·192020	·217419	·242819	·268218	·293618
·57	·014477	·039877	·065276	·090676	·116075	·141475	·166874	·192274	·217673	·243073	·268472	·293872
·58	·014731	·040131	·065530	·090930	·116329	·141729	·167128	·192528	·217927	·243327	·268726	·294126
·59	·014985	·040385	·065784	·091184	·116583	·141983	·167382	·192782	·218181	·243581	·268980	·294380
·60	·015239	·040639	·066038	·091438	·116837	·142237	·167636	·193036	·218435	·243835	·269234	·294634
·61	·015493	·040893	·066292	·091692	·117091	·142491	·167890	·193290	·218689	·244089	·269488	·294888
·62	·015747	·041147	·066546	·091946	·117345	·142745	·168144	·193544	·218943	·244343	·269742	·295142
·63	·016001	·041401	·066800	·092200	·117599	·142999	·168398	·193798	·219197	·244597	·269996	·295396
·64	·016255	·041655	·067054	·092254	·117853	·143253	·168652	·194052	·219451	·244851	·270250	·295650
·65	·016509	·041909	·067308	·092708	·118107	·143507	·168906	·194306	·219705	·245105	·270504	·295904

12 inches = 1 foot = ·304794 metres.

Table No. 35.

Table of Meters equivalent to each $\frac{1}{100}$ of an inch.

Inches	0	1	2	3	4	5	6	7	8	9	10	11
·66	·016763	·042163	·067562	·092962	·118361	·143761	·169160	·194560	·219959	·245359	·270758	·296158
·67	·017017	·042417	·067816	·093216	·118615	·144015	·169414	·194814	·220213	·245613	·271012	·296412
·68	·017271	·042671	·068070	·093470	·118869	·144269	·169668	·195068	·220467	·245867	·271266	·296666
·69	·017525	·042925	·068324	·093724	·119123	·144523	·169922	·195322	·220721	·246121	·271520	·296920
·70	·017779	·043179	·068578	·093978	·119377	·144777	·170176	·195576	·220975	·246375	·271774	·297174
·71	·018033	·043433	·068832	·094232	·119631	·145031	·170430	·195830	·221229	·246629	·272028	·297428
·72	·018287	·043687	·069086	·094486	·119885	·145285	·170684	·196084	·221483	·246883	·272282	·297682
·73	·018541	·043941	·069340	·094740	·120139	·145539	·170938	·196338	·221737	·247137	·272536	·297936
·74	·018795	·044195	·069594	·094994	·120393	·145793	·171192	·196592	·221991	·247391	·272790	·298190
·75	·019049	·044449	·069848	·095248	·120647	·146047	·171446	·196846	·222245	·247645	·273044	·298444
·76	·019303	·044703	·070102	·095502	·120901	·146301	·171700	·197100	·222499	·247899	·273298	·298698
·77	·019557	·044957	·070356	·095756	·121155	·146555	·171954	·197354	·222753	·248153	·273552	·298952
·78	·019811	·045211	·070610	·096010	·121409	·146809	·172208	·197608	·223007	·248407	·273806	·299206
·79	·020065	·045465	·070864	·096264	·121663	·147063	·172462	·197862	·223261	·248661	·274060	·299460
·80	·020319	·045719	·071118	·096518	·121917	·147317	·172716	·198116	·223515	·248915	·274314	·299714
·81	·020573	·045973	·071372	·096772	·122171	·147571	·172970	·198370	·223769	·249169	·274568	·299968
·82	·020827	·046227	·071626	·097026	·122425	·147825	·173224	·198624	·224023	·249423	·274822	·300222
·83	·021081	·046481	·071880	·097280	·122679	·148079	·173478	·198878	·224277	·249677	·275076	·300476
·84	·021335	·046735	·072134	·097534	·122933	·148333	·173732	·199132	·224531	·249931	·275330	·300730
·85	·021589	·046989	·072388	·097788	·123187	·148587	·173986	·199386	·224785	·250185	·275584	·300984
·86	·021843	·047243	·072642	·098042	·123441	·148841	·174240	·199640	·225039	·250439	·275838	·301238
·87	·022097	·047497	·072896	·098296	·123695	·149095	·174494	·199894	·225293	·250693	·276092	·301492
·88	·022351	·047751	·073150	·098550	·123949	·149349	·174748	·200148	·225547	·250947	·276346	·301746
·89	·022605	·048005	·073404	·098804	·124203	·149603	·175002	·200402	·225801	·251201	·276600	·302000
·90	·022859	·048259	·073658	·099058	·124457	·149857	·175256	·200656	·226055	·251455	·276854	·302254
·91	·023113	·048513	·073912	·099312	·124711	·150111	·175510	·200910	·226309	·251709	·277108	·302508
·92	·023367	·048767	·074166	·099566	·124965	·150365	·175764	·201164	·226563	·251963	·277362	·302762
·93	·023621	·049021	·074420	·099820	·125219	·150619	·176018	·201418	·226817	·252217	·277616	·303016
·94	·023875	·049275	·074674	·100074	·125473	·150873	·176272	·201672	·227071	·252471	·277870	·303270
·95	·024129	·049529	·074928	·100328	·125727	·151127	·176526	·201926	·227325	·252725	·278124	·303524
·96	·024383	·049783	·075182	·100582	·125981	·151381	·176780	·202180	·227579	·252979	·278378	·303778
·97	·024637	·050037	·075436	·100836	·126235	·151635	·177034	·202434	·227833	·253233	·278632	·304032
·98	·024891	·050291	·075690	·101090	·126489	·151889	·177288	·202688	·228087	·253487	·278886	·304286
·99	·025145	·050545	·075944	·101344	·126743	·152143	·177542	·202942	·228341	·253741	·279140	·304540

12 inches = 1 foot = ·304794 metres.

Table of Kilograms equivalent to each $\frac{1}{10}$ of Pounds Avoirdupois.

Pounds Avoirdupois	0	1	2	3	4	5	6	7	8	9
·0		·453593	·907185	1·36078	1·81437	2·26796	2·72156	3·17515	3·62874	4·08233
·1	·045359	·498952	·952544	1·40613	1·85973	2·31331	2·76691	3·22051	3·67410	4·12769
·2	·090718	·544311	·997903	1·45149	1·90509	2·35867	2·81227	3·26587	3·71946	4·17305
·3	·136078	·589671	1·043263	1·49685	1·95045	2·40403	2·85763	3·31122	3·76482	4·21841
·4	·181437	·635030	1·088622	1·54221	1·99581	2·44939	2·90299	3·35658	3·81018	4·26377
·5	·226796	·680389	1·133981	1·58757	2·04117	2·49475	2·94835	3·40194	3·85554	4·30913
·6	·272156	·725749	1·179341	1·63293	2·08653	2·54011	2·99371	3·44730	3·90090	4·35449
·7	·317515	·771108	1·224700	1·67829	2·13189	2·58547	3·03907	3·49266	3·94626	4·39985
·8	·362874	·816467	1·270059	1·72365	2·17725	2·63083	3·08443	3·53802	3·99162	4·44521
·9	·408233	·861826	1·315418	1·76901	2·22260	2·67619	3·12978	3·58338	4·03697	4·49057

Table of Kilograms equivalent to Pounds Avoirdupois.

Pounds Avoirdupois	0	1	2	3	4	5	6	7	8	9
0		·453593	·90718	1·36078	1·81437	2·26796	2·72156	3·17515	3·62875	4·08233
10	4·535927	4·98952	5·44312	5·89671	6·35030	6·80390	7·25749	7·71108	8·16467	8·61827
20	9·071853	9·52545	9·97904	10·4326	10·8862	11·3398	11·7934	12·2470	12·7006	13·1542
30	13·60780	14·0614	14·5150	14·9686	15·4222	15·8757	16·3293	16·7829	17·2365	17·6901
40	18·14371	18·5973	19·0509	19·5045	19·9581	20·4117	20·8653	21·3189	21·7725	22·2260
50	22·67963	23·1332	23·5868	24·0404	24·4940	24·9476	25·4012	25·8548	26·3084	26·7620
60	27·21556	27·6691	28·1227	28·5763	29·0299	29·4835	29·9371	30·3907	30·8443	31·2978
70	31·75149	32·2051	32·6587	33·1122	33·5658	34·0194	34·4730	34·9266	35·3802	35·8338
80	36·28741	36·7410	37·1946	37·6482	38·1018	38·5554	39·0090	39·4626	39·9162	40·3697
90	40·82334	41·2769	41·7305	42·1841	42·6377	43·0913	43·5449	43·9985	44·4521	44·9057

Table No. 37.

Table of Kilograms per meter equivalent to Pounds per foot.

Pounds per foot	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
0		1·4882	2·9764	4·4646	5·9528	7·4410	8·9292	10·417	11·905	13·393	14·882	16·370	17·858	19·346	20·834	22·323	23·811	25·299	26·787	28·275
·1	·14882	1·6370	3·1252	4·6134	6·1016	7·5898	9·0780	10·565	12·053	13·541	15·030	16·518	18·006	19·494	20·982	22·471	23·959	25·447	26·935	28·423
·2	·29764	1·7858	3·2740	4·7622	6·2504	7·7386	9·2268	10·714	12·202	13·690	15·179	16·667	18·155	19·643	21·131	22·620	24·108	25·596	27·084	28·572
·3	·44646	1·9346	3·4228	4·9110	6·3992	7·8874	9·3756	10·863	12·351	13·839	15·328	16·816	18·304	19·792	21·280	22·769	24·257	25·745	27·233	28·721
·4	·59528	2·0834	3·5716	5·0598	6·5480	8·0362	9·5244	11·012	12·500	13·988	15·477	16·965	18·453	19·941	21·429	22·918	24·406	25·894	27·382	28·870
·5	·74410	2·2323	3·7205	5·2087	6·6969	8·1851	9·6733	11·161	12·649	14·138	15·626	17·114	18·602	20·090	21·578	23·067	24·555	26·043	27·531	29·019
·6	·89292	2·3811	3·8693	5·3575	6·8457	8·3339	9·8221	11·310	12·797	14·285	15·774	17·262	18·750	20·238	21·726	23·215	24·703	26·191	27·679	29·167
·7	1·04174	2·5299	4·0181	5·5063	6·9945	8·4827	9·9709	11·458	12·946	14·434	15·923	17·411	18·899	20·387	21·875	23·364	24·852	26·340	27·828	29·316
·8	1·19056	2·6787	4·1669	5·6551	7·1433	8·6315	10·1197	11·607	13·095	14·583	16·072	17·560	19·048	20·536	22·024	23·513	25·001	26·489	27·977	29·465
·9	1·3393	2·8275	4·3157	5·8039	7·2921	8·7803	10·2685	11·756	13·244	14·732	16·221	17·709	19·197	20·685	22·173	23·662	25·150	26·638	28·126	29·614

Pounds per foot	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39
0	29·764	31·252	32·740	34·228	35·716	37·205	38·693	40·181	41·669	43·157	44·646	46·134	47·622	49·110	50·598	52·087	53·575	55·063	56·551	58·039
·1	29·912	31·400	32·888	34·376	35·864	37·353	38·841	40·329	41·817	43·305	44·794	46·282	47·770	49·259	50·746	52·235	53·723	55·211	56·699	58·187
·2	30·061	31·549	33·037	34·525	36·013	37·502	38·990	40·478	41·966	43·454	44·943	46·431	47·919	49·407	50·895	52·384	53·872	55·360	56·848	58·336
·3	30·210	31·698	33·186	34·674	36·162	37·651	39·139	40·627	42·115	43·603	45·092	46·580	48·068	49·556	51·044	52·533	54·021	55·509	56·997	58·485
·4	30·359	31·847	33·335	34·823	36·311	37·800	39·288	40·776	42·264	43·752	45·241	46·729	48·217	49·705	51·193	52·682	54·170	55·658	57·146	58·634
·5	30·508	31·996	33·484	34·972	36·460	37·949	39·437	40·925	42·413	43·901	45·390	46·878	48·366	49·854	51·342	52·831	54·319	55·807	57·295	58·783
·6	30·656	32·144	33·632	35·120	36·609	38·097	39·585	41·073	42·561	44·049	45·538	47·026	48·514	50·002	51·490	52·979	54·467	55·955	57·443	58·931
·7	30·805	32·293	33·781	35·269	36·757	38·246	39·734	41·222	42·710	44·198	45·687	47·175	48·663	50·151	51·639	53·128	54·616	56·104	57·592	59·080
·8	30·354	32·442	33·930	35·418	36·906	38·395	39·883	41·371	42·859	44·347	45·836	47·324	48·812	50·300	51·788	53·277	54·765	56·253	57·741	59·229
·9	31·103	32·591	34·079	35·567	37·056	38·544	40·032	41·520	43·008	44·496	45·985	47·473	48·961	50·449	51·937	53·426	54·914	56·402	57·890	59·378

Pounds per foot	40	42	43	44	45	46	47	48	49	50	55	60	65	70	75	80	85	90	95	100
0	59·528	62·504	63·992	65·480	66·969	68·457	69·945	71·433	72·921	74·410	81·851	89·292	96·733	104·174	111·615	119·056	126·497	133·938	141·379	148·820
·25	59·900	62·876	64·364	65·852	67·341	68·829	70·317	71·805	73·293	74·782	82·223	89·664	97·105	104·546	111·987	119·428	126·869	134·310	141·751	149·192
·50	60·272	63·248	64·736	66·224	67·713	69·201	70·689	72·177	73·665	75·154	82·595	90·036	97·477	104·918	112·359	119·800	127·241	134·682	142·123	149·564
·75	60·644	63·620	65·108	66·596	68·085	69·573	71·061	72·549	74·037	75·526	82·967	90·408	97·849	105·290	112·731	120·172	127·613	135·054	142·495	149·936

EXPLANATION OF TABLES.

GIVING STANDARDS FOR PUNCHING, STANDARD CAST SEPARATORS, STANDARD BEAM BRACKETS AND EQUIVALENTS OF ENGLISH AND METRIC SYSTEMS.

Table No. 28 gives the standard dimension for punching the flanges of beams, channels and angles, and will be very useful in laying out and designing work.

Table No. 29 gives the dimensions and details of cast iron separators as used between beams when they are placed together to form girders.

Table No. 30 gives the standard dimension for brackets at the ends of beams where they connect one with the other.

Table No. 31 shows the different forms of columns which may be constructed by riveting together different classes of rolled steel. An infinite number could be made by making different combinations but those shown are the ones most commonly used.

Tables 32 to 37 inclusive will be found very useful for transferring weights and measures from the Metric to the English system or vice-versa.

Plate No. 32.

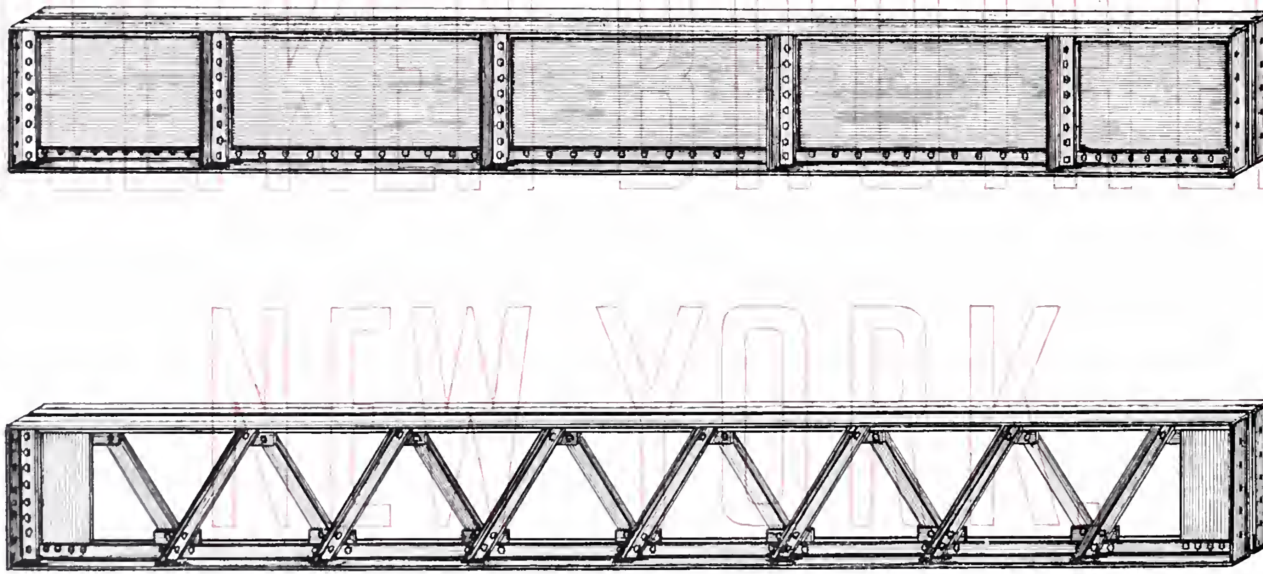


Plate No. 33.

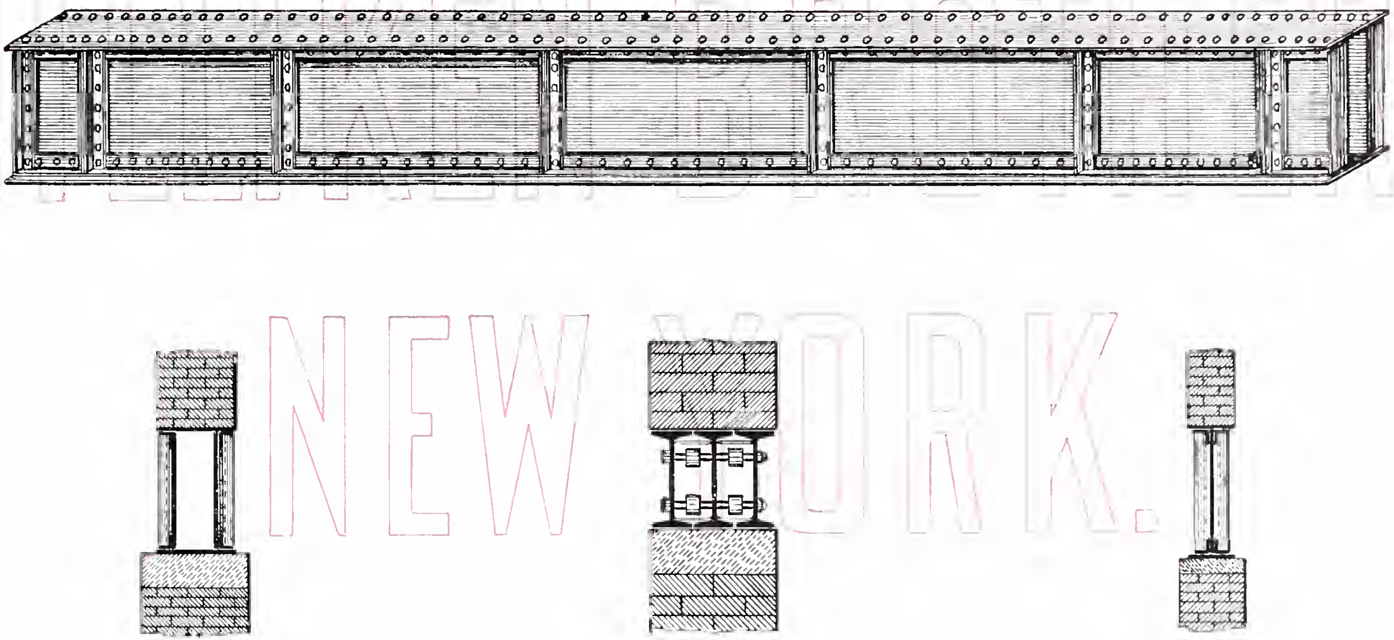


Plate No. 34.

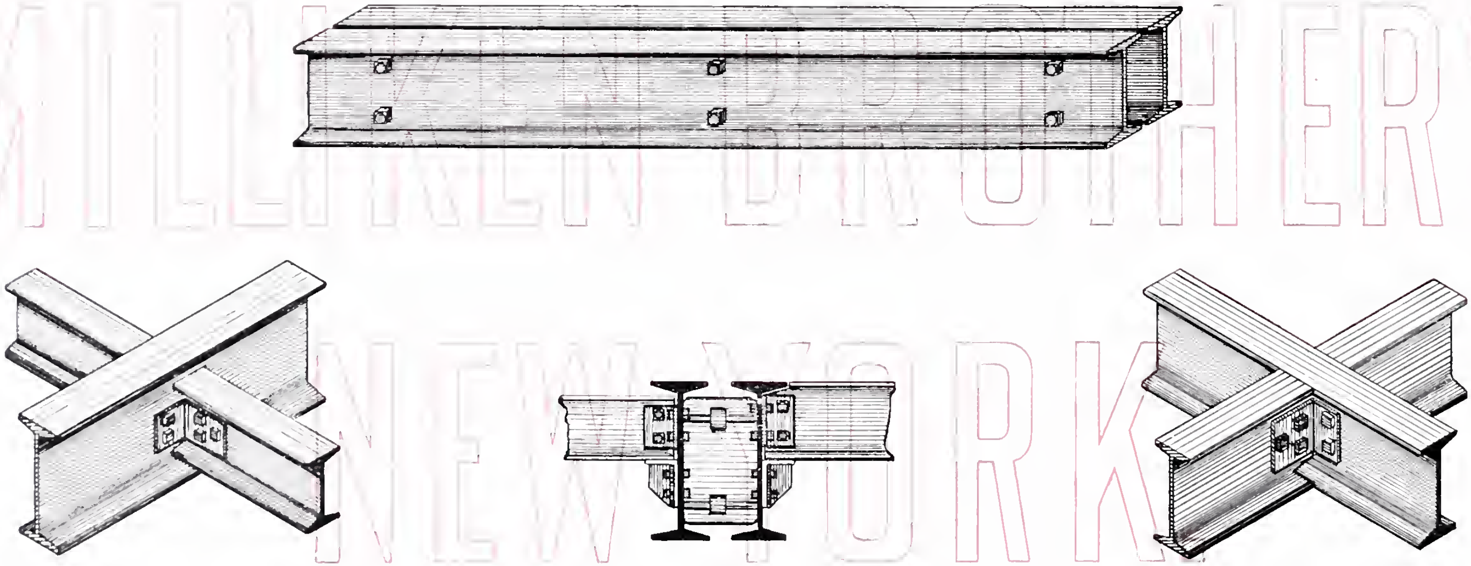


Plate No. 35.

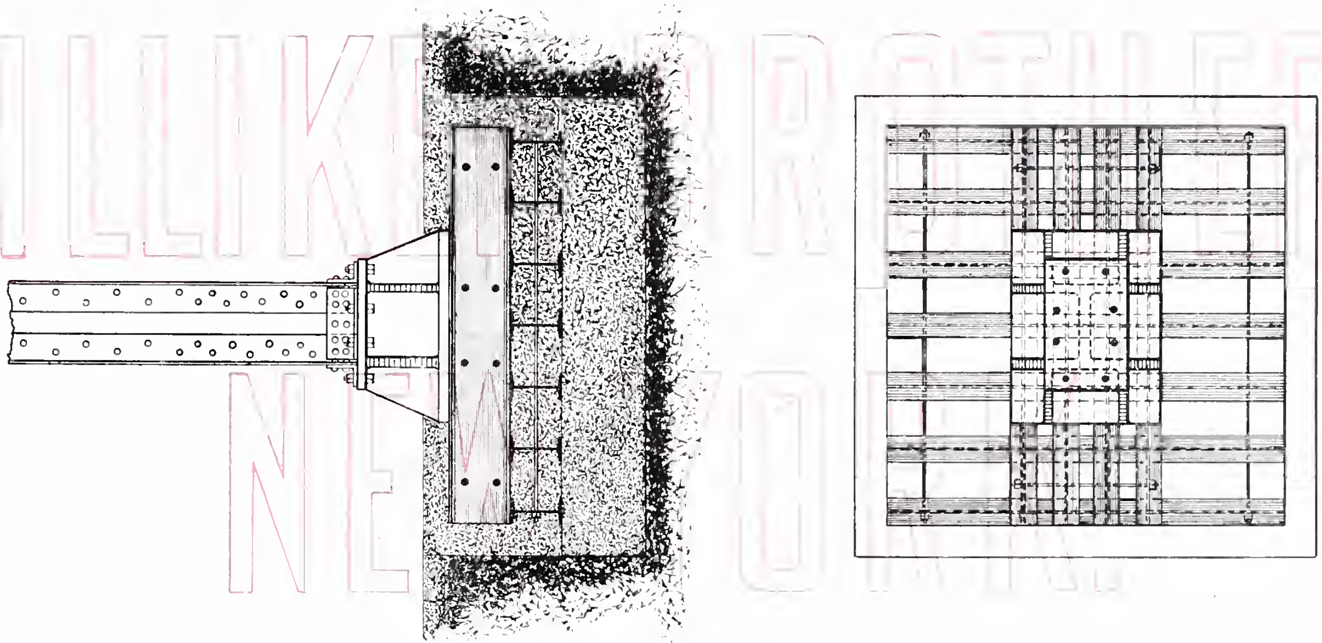
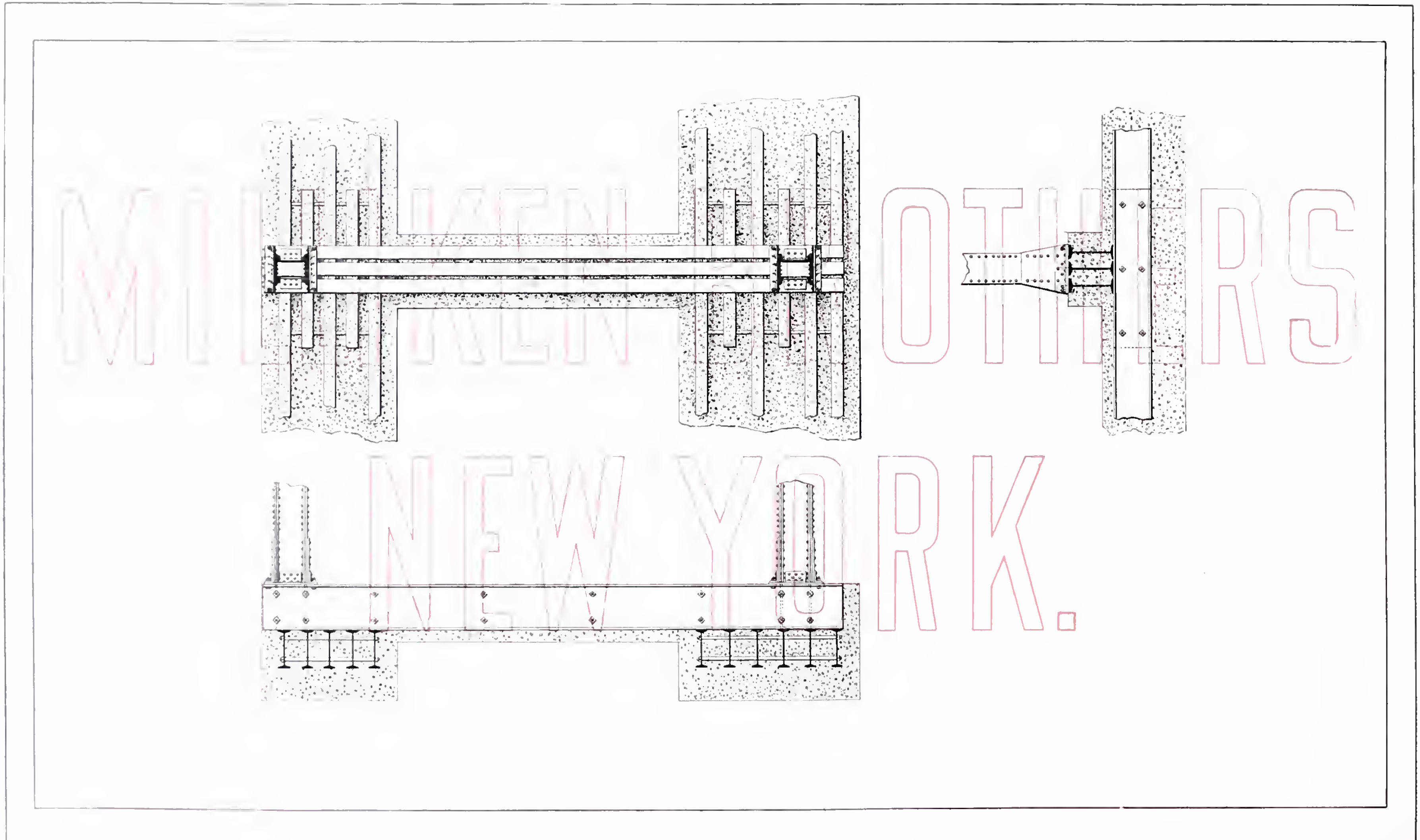


Plate No. 36.



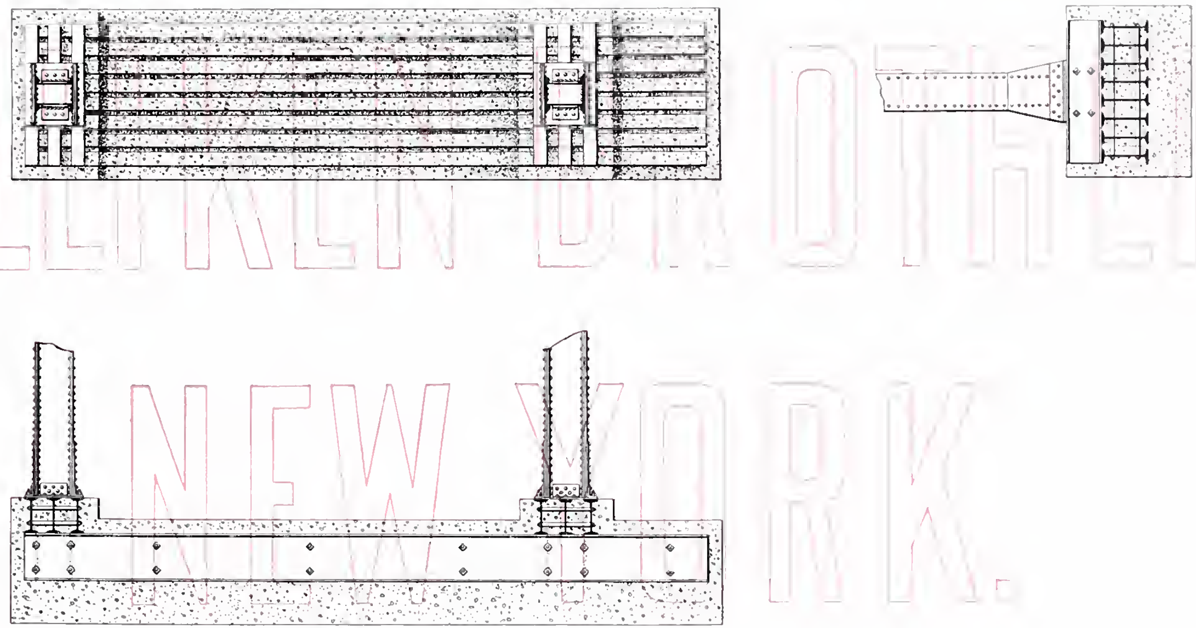


Plate No. 38.

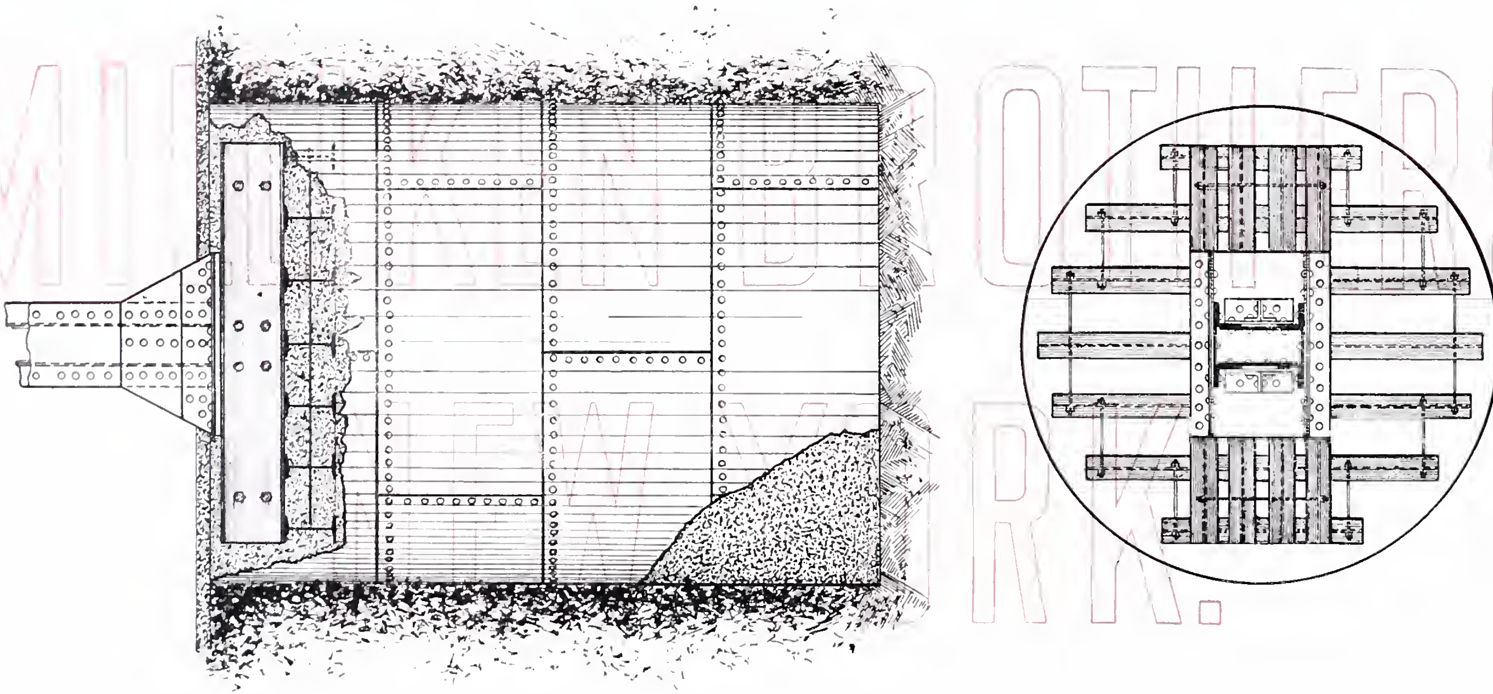


Plate No. 39.

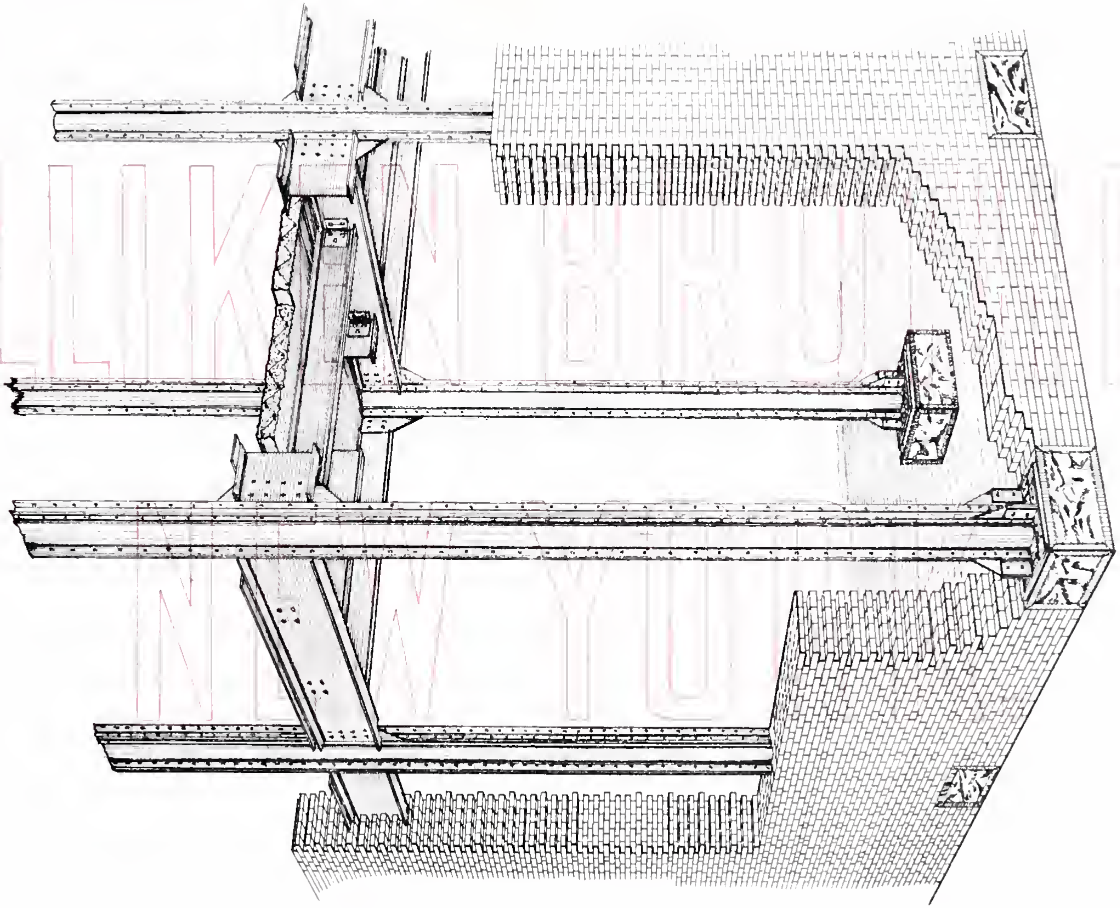


Plate No. 40.

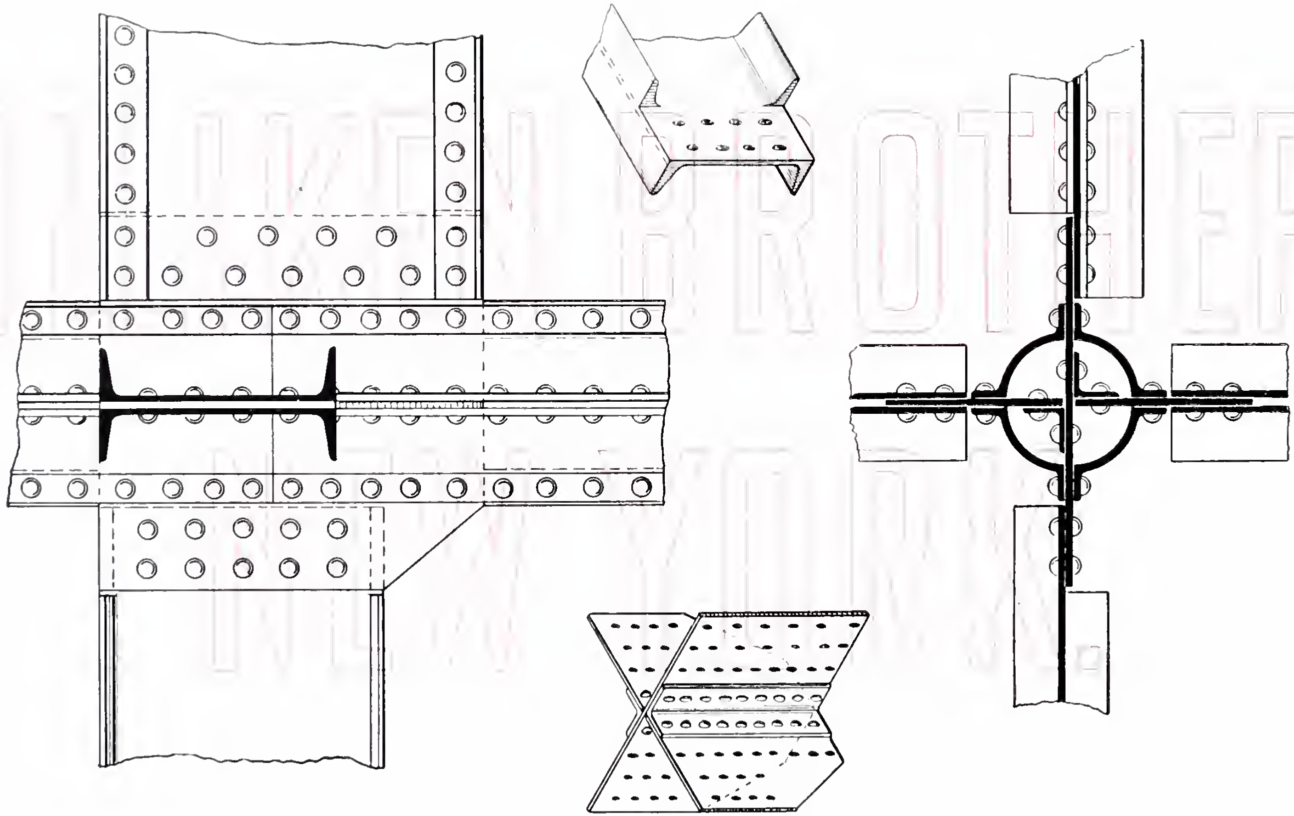


Plate No. 41.

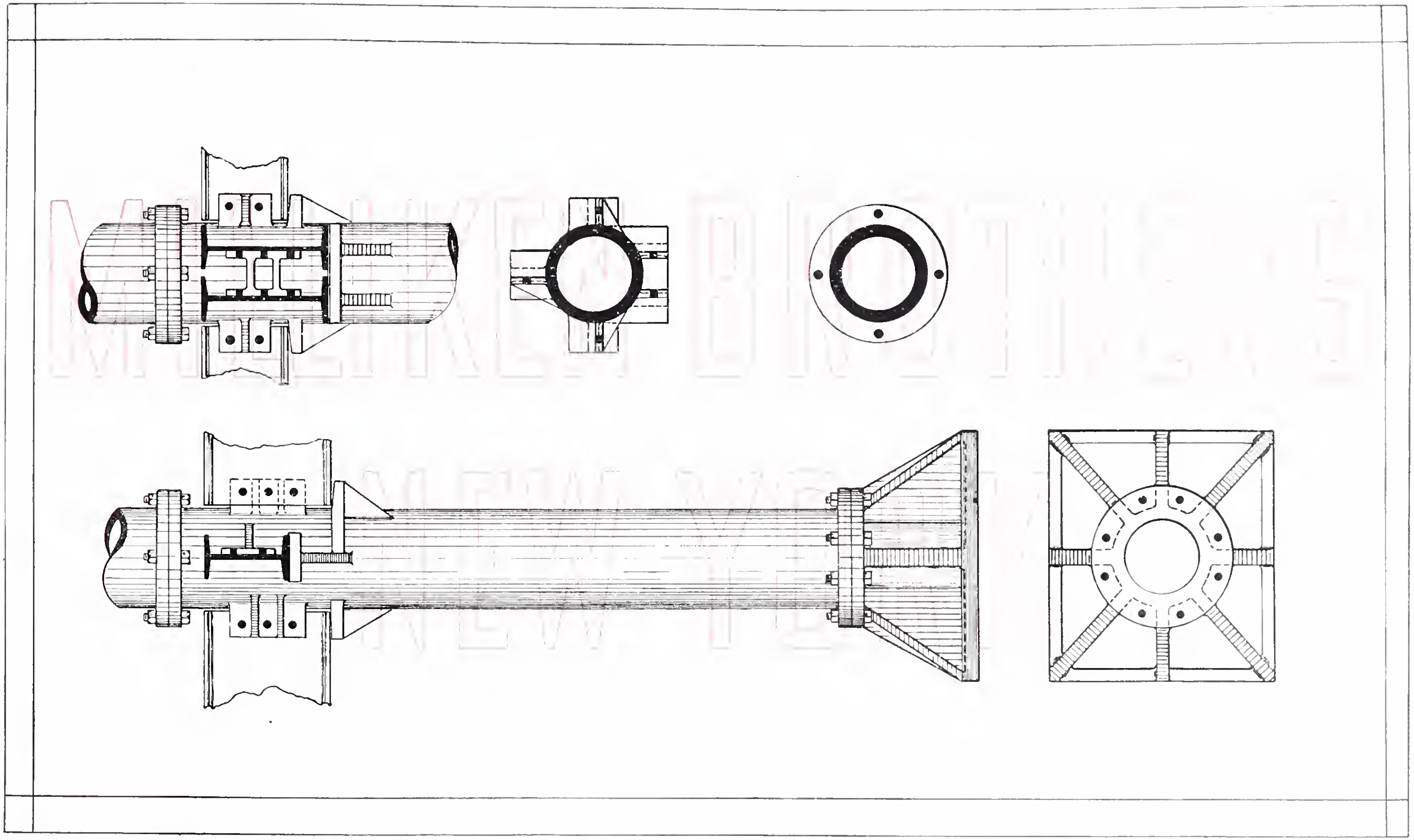
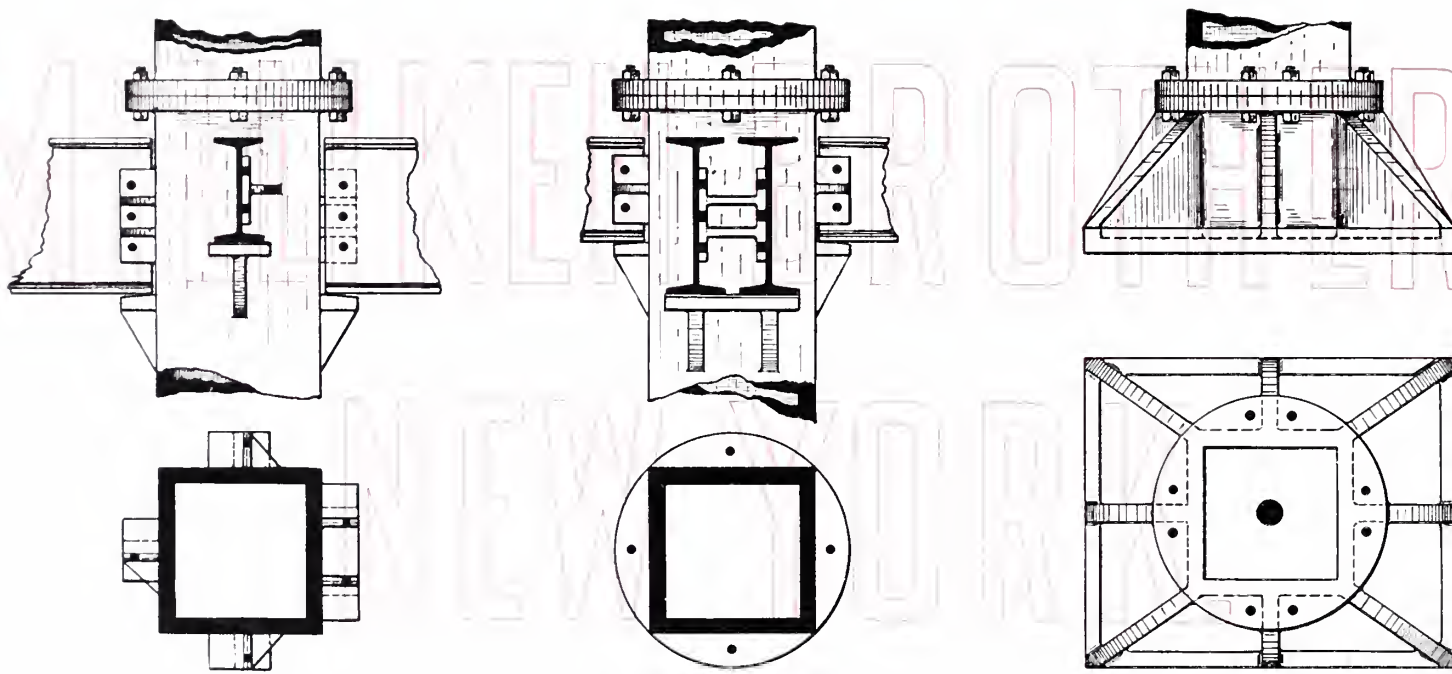


Plate No. 42.



STRUCTURAL STEEL WORK AS USED IN OFFICE BUILDINGS, STORES, WAREHOUSES, ETC.

Owing to the large quantity of perishable goods stored in buildings, and to the number of lives often at stake, it has become the custom now in all large cities, to construct important buildings in a fire-proof manner. Due to the cheapness of steel and to the skill with which it is made use of in buildings, its use is becoming more and more general; as a result, buildings, properly designed of steel construction are practically indestructible, and will last for an indefinite number of years. The very latest method of using steel for high buildings is distinctively American, and is known as the Skeleton Construction Plan, which will be described in detail later on.

This method of construction, moreover, lends itself to a rapid erection of the building, which is an item of great importance to an owner. It not only enables an owner to occupy a new building in the shortest possible time, but it saves interest on the cost of the investment during the building of it.

Another important matter for an owner to consider, is the question of insurance. Outside of the question of the insurance on the building itself, when built in a fire-proof manner, is the question of the insurance on the goods stored in the building. The difference in the cost of insurance between a fire-proof and a non-fire-proof structure, will often pay for the small difference between steel and wood construction.

In tropical countries woods suitable for building purposes are unknown, and have to be imported, and in many countries wood so rapidly decays and rots, that the life of a wooden structure is limited, while a steel structure is practically indestructible.

In countries which are subject to earthquakes, our experience teaches us that the only suitable and proper building is the one constructed of steel on a skeleton principle. In this building, the structure is entirely tied together, the same as a railroad bridge, and it is next to impossible to pull it apart or to get the building out of plumb.

Generally, the construction of a fire-proof floor is made by supporting the floor on columns, which may be either of cast iron or rolled steel of various sections, as shown in table No. 31. We do not recommend cast iron columns for export work, for reasons that will be given later on.

The columns that support the floors rest in turn on foundations composed usually of brick or concrete. The foundations are usually capped with a large stone, dressed straight and smooth, on which the shoe of the column rests. This stone should be considerably larger than the base of the column, the exact size depending on the load to be transmitted.

The kind of material which should be used in the construction of the part of the foundation immediately below the stone, and also the thickness of the stone itself, can only be determined by calculation, and depends largely on the load to be carried, and the exact nature of the soil on which the building rests. In cases of extra heavy loads, and where the earth is not very hard or compact, or where there is any moisture or water, it is customary to use a grillage composed of steel beams set close together, and carefully encased in concrete. This is clearly shown on Plate No. 35. The shoe of the column then rests on top of these beams, the idea being to distribute the load borne by the column over a sufficiently large surface of the soil. Sometimes it becomes necessary owing to the nature of the soil, to sink caissons, to carry the foundations down to rock.

These caissons are usually made of heavy steel plates, circular or square in form, similar to construction shown on Plate No. 38.

After the caisson is sunk, the earth or soil should all be removed from these cylinders or tanks, and the entire inside of same filled with concrete, and on this concrete foundation, grillage beams rest. In cases where large quantities of water are found, or where quicksands occur, or where the depth that the caisson has to be sunk is very great, compressed air is resorted to, and the excavations made under air pressure.

Grillage foundations are often more or less complicated. Sometimes owing to the combination of the load to be carried and the nature of the soil, it is neccessary to make what are called Continuous Grillage Foundations. These are shown on Plate No. 37. It is often necessary in supporting the side walls or columns of a structure, where there is an adjoining building, to support these outside loads by cantilever construction. This is clearly shown on Plate No. 36.

While the sketches which we have shown in connection with grillage foundation work are all shown as composed of solid rolled beams, it is often necessary, where very heavy loads are to be carried, to resort to the use of riveted girders.

The question of the kind of columns to use, is determined more or less by the load the column has to carry, and what the building is intended to be used for. Cast iron columns are sometimes employed and the outside can be ornamented to any extent desired, as fully explained in the latter part of this catalogue, but we do not recommend them for export work.

The shafting of the column can be either plain, as shown on Plate No. 41, in which case the shaft of the column is left exposed to view in the building, or it may be surrounded by some form of fire-proofing, such as cement or some of the harder kinds of plasters, which latter are often finished in imitation marble. Of course, cast iron columns can be furnished, either round or square. (See Plate No. 42 showing the details of square cast iron columns).

We do not advocate using cast iron columns, for several reasons. First—because it is almost impossible to manufacture a perfect column in this metal, as cast iron is more or less liable to have flaws or imperfections it is impossible to detect. Our second reason is, because in shipping this class of goods out of the country, castings are very apt to be handled during transit in a rough manner and get broken, and if the break happens to be a bad one it is impossible to fix it, and the column has to be duplicated, thereby losing, in most cases, valuable time.

We therefore strongly recommend the use of steel columns fabricated of rolled steel sections, which are not open to the objections as named above. Owing to the difference in weight, it will be found that the price of steel columns is about the same as that of cast iron ones. Of the different kinds of rolled steel columns that are generally used, we recommend columns formed of either angles and plates, channels and plates, the Zee bar column, or Phoenix column. All of these columns lend themselves to building construction. The details of the columns are fully explained in the preceding plates.

If the Phoenix columns are used, we would recommend what is known as the "Cross Pintle Connection," shown on Plate No. 40.

The floors of the building are constructed by spanning beams from column to column, or if one single beam will not carry the load, then use two beams, or a riveted girder of either single web or box construction Sketch of the single web girder is shown on the upper part of Plate No. 32, and the open-work or lattice girder is shown on the lower part of the same plate. Sketch of the box girder is shown on the upper part of Plate No. 33.

If two beams are used to make a girder, it is necessary to connect them by means of cast iron separators. These are detailed in Table No. 29. The use of these separators is shown on the central and lower part of Plate No. 33 and on Plate No. 34.

There are several different methods of securing floor beams to the girders. Sometimes the floor beams

rest on top of the girders and are simply secured to the girders by means of bolts through the flanges. We do not consider this good construction, as it does not stiffen the floor, and it also takes off from the height of the room below, besides the girder projects below the floor beams.

It is usual to attach the floor beams to the web of the girder, or to other beams by means of brackets, as shown in detail, Table No. 30. Two brackets are required for each beam connection. These brackets are shown in the sketch on Plate No. 34. The brackets are usually bolted to the beams and girders. When the top of the floor beams and top of the girder are level, it is necessary to cut out the flange of the floor beam. This is called coping, sketch of which is shown on Plate No. 34, the lower right hand sketch. When the beam is dropped below the flange of the girder, or other beam, the coping is not necessary. The same is shown on Plate No. 34, the lower left hand sketch.

It is always advisable in designing a floor, to have one of the floor beams come opposite to the column connection, so as to stiffen the column at the floor level.

In the case of a low building, in which the loads are not very great, it is advisable to build the walls of the building of brick or stone, and to allow the floor beams to rest on the wall, but where the building is of considerable height, and the floor loads great, it is always advisable to have a line of beams or girders just inside the wall, to support the end of the floor beams on such beam or girder, and thus make the walls of the building independent of the floor construction.

In other cases where the building is very high, it is desirable to not only support the floor independent of the walls, but in addition, to carry the walls themselves on the steel work, which is known as full skeleton construction. The walls in this case are supported at each floor level, by the iron work, and the walls are simply a shell, to keep the weather out, and the mason work does not therefor carry any loads. See Plate No. 39, which shows a portion of a building, illustrating generally, matters regarding the above.

It will be noticed from this Plate that the mason work projects outside of the girders at the floor level,

usually to the extent of about four (4) inches, and this is necessary in order to thoroughly fire-proof the girders. In other words, protect them from fire in an adjoining building. The floor itself, in order to be fire-proof, must be constructed of some indestructible material. Later on in this catalogue, we give full information on this particular subject.

The construction of the floor itself, and the loads to be carried, both dead and live load, determine the distance that the floor beams should be spaced apart. The following are the loads which we recommend for different classes of buildings, that is, the load which the floor should be figured to sustain, not including the weight of the construction of the floor itself, or the weight of the beams themselves, both of which must be added in making calculation of the sizes required for the floor beams and girders.

70 lbs. per square foot for floors of dwelling houses and offices, equal to 341.7825 kilos per square metre.

125 lbs. per square foot for floors of churches, theatres and ballrooms, equal to 613.3257 kilos per square metre.

200 to 250 lbs. per square foot for floors of warehouses, equal to 976.5215 to 1220.6519 kilos per square metre.

250 to 400 lbs. per square foot for floors for heavy machinery equal to 1220.6519 to 1953.043 kilos per square metre.

Plate No. 43.

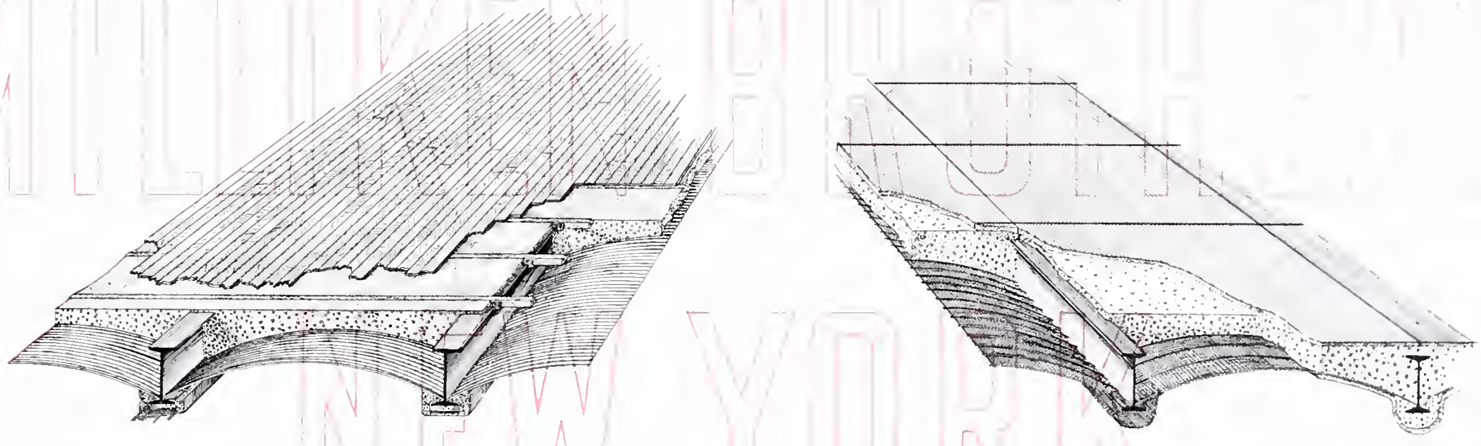


Plate No. 44.

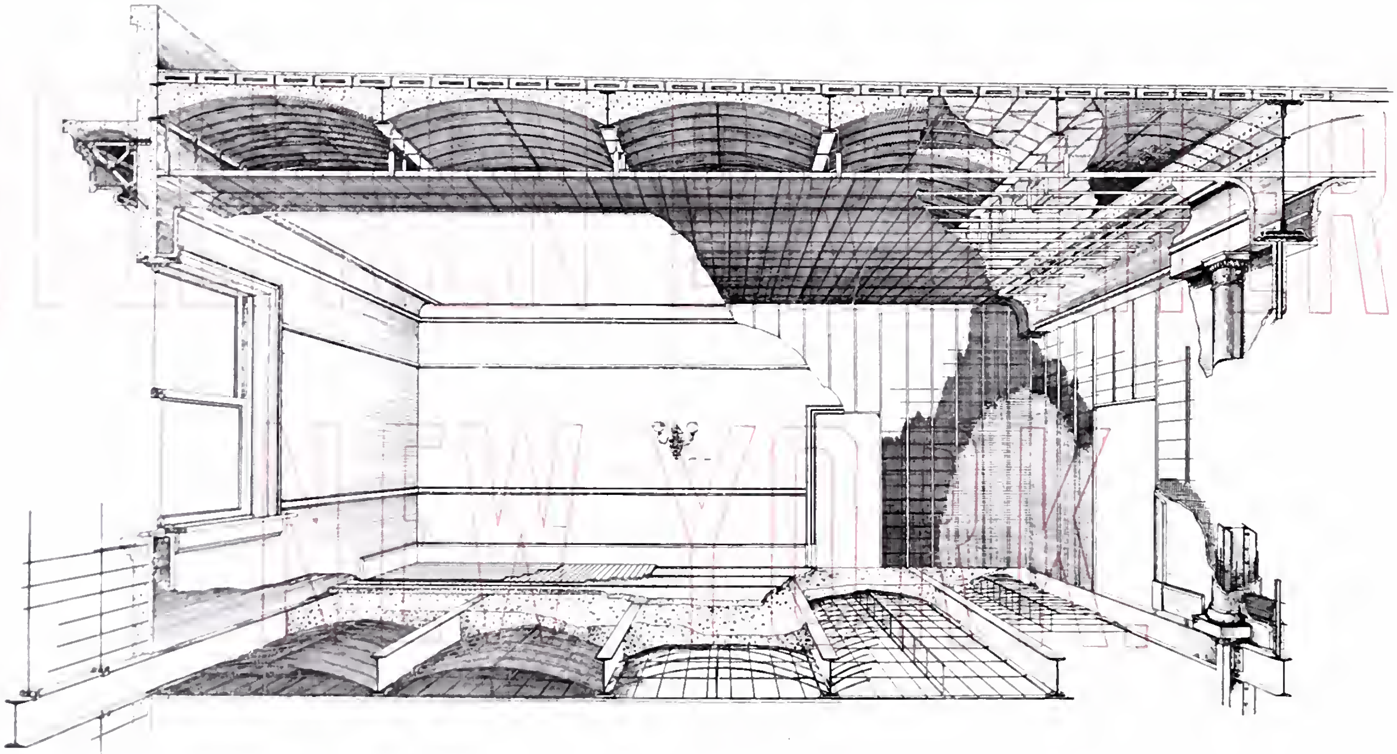
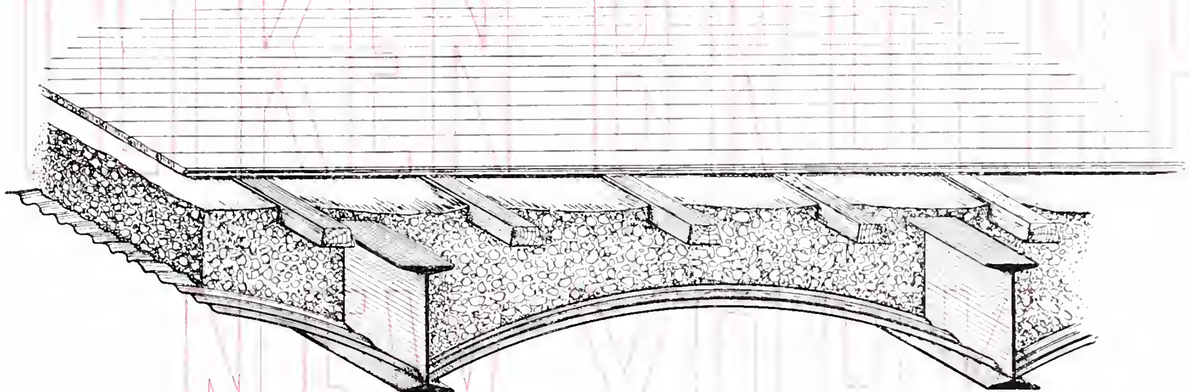


Plate No. 45.



CONSTRUCTION OF COMPLETE FIRE-PROOF OFFICE BUILDINGS, STORES, WAREHOUSES, ETC.

In extending our business for furnishing structural steel and iron work for foreign countries, we have been constantly reminded by our foreign customers, that while they understand the theory of fire-proof buildings, and while it is possible for them to purchase the structural steel and iron work, it is a difficult thing for them to intelligently explain to the other contractors who are required to complete the building, just how their portion of the work has to be done, particularly when it comes to skeleton steel constructed buildings; in other words, it is easy enough to get the steel frame, but it is a difficult matter to get the balance of the work, and have the balance of the work agree with the steel work, and produce a building such as constructed in the United States.

In order to overcome this trouble, we have in the last few years made it a practice to not only design, but actually to wholly construct and furnish completed buildings, embracing all the different classes of work that enter into the construction of same, and have added to our regular engineering force, departments with specially skilled engineers, who have charge of such classes of work as fire-proofing, mason work, carpenter work, plumbing, heating, lighting, ventilating, etc., etc., and we are now fully equipped and prepared to undertake the furnishing and erecting of completed buildings in any foreign country.

By this means we are enabled to give our foreign customers not only a completed building, but to give

them all of the thousand and one ingenious American devices that are used in the construction of office buildings, stores, warehouses, etc., etc., for which the American people are so celebrated.

Anyone who has visited New York City will admit that the American methods of plumbing, heating lighting and ventilating are second to none in the world. For office buildings particularly the Americans have many conveniences which are not used in any other country. We are prepared, where customers desire, to take the land just as we find it and erect on the same a completed building, including the excavation, the necessary foundations, building of the cellar, building of vaults, water-proofing, floor construction, walls, including cut stone if necessary, all of the carpenter work, roof work, interior iron work—including stairs, grills, etc.—elevators, plumbing, lighting, heating, ventilating, and in fact, turn the building over absolutely completed, including the decoration if necessary.

We are also prepared to submit drawings and specifications covering all of these different classes of work, or will be glad to estimate on plans and specifications as furnished to us, making such suggestions as we think advisable to meet with the best American practice.

A large part of our foreign business extends to tropical countries, where the climatic conditions are peculiar. We have had a very large experience in constructing buildings in the tropics, and have introduced a number of novel features in some of these buildings.

It is a well-known fact that in the tropics the nights are comparatively cool, as compared with the temperature of the day-time. In order to protect the interior of the building from the heat of the sun, we have designed the peculiar construction known as hollow walls. The outside wall is composed of concrete reinforced with metal; immediately back of this wall is an air space, and then inside of this, light iron frame work on which plaster is placed, the idea being to prevent, by means of the air space, the heat radiating through the wall.

Confined air is one of the best non-conductors of heat and we find that this air space back of the wall

prevents the heat of the sun, during the day-time, penetrating to the rooms. The outside of the building is finished in concrete and made as ornamental as desired. Of course the outside of the building can be made of cut stone, brick or any other material that is desired. This form of construction is shown on plate No. 44.

In tropical countries the contents of buildings often suffer from moisture and mildew. The air space in the wall prevents the moisture striking through the wall and leaves the inside of the building perfectly dry. The upper story of the building is also protected from the heat of the sun on the roof by means of hanging the ceiling in the upper story and forming an air space between the ceiling and roof. In tropical countries and in fact all countries, it is a very difficult matter to construct a roof that is thoroughly water-tight and which will remain water-tight an indefinite length of time. We believe we have solved this problem by a special form of construction that we use, for not only making the upper surface of the roof water-tight, but protecting it from the rays of the sun, and at the same time finishing it so that persons can walk on it without damage to the water-proof surface. This is all clearly shown in plate No. 44.

It is very desirable especially in tropical countries to arrange the building so that there is a free circulation of air. This is accomplished by arranging the windows and doors so that the air can enter, carrying the windows up to the underside of the ceiling and ventilating the entire building through an open court in the centre, which open court acts on the same principle as a chimney.

It is absolutely necessary in order to construct a fire-proof building to have the steel work so protected that even in case the contents of the building should burn, the heat will not be communicated to the steel work itself. This is done by encasing the columns that occur in the walls in concrete material. In the floors we advocate the use of concrete in an arch form. The arch is formed by using the centre of either wire work or corrugated sheet iron on which the concrete is placed. After the concrete is set the metal centre is not necessary as far as strength is concerned. The underside of the flanges of the beam is protected by concrete as shown in plate No. 43. In the case of a flat level ceiling, plaster is applied on furring and wire lathing

stretched on the underside of the beam flanges, as shown in plate No. 44. The advantages of this last named form of construction are many: It not only gives a flat ceiling, which is a better effect for offices, but it introduces an air space which is a good non-conductor of heat and cold, and makes the floors more sound proof, and is a convenient place for the running of mains for water, gas and electric light. The upper surface of the floor can be finished with wooden sleepers and boards as shown in plate No. 45, or it can be finished in plain cement. This last we advocate as it removes any danger of fire from the wooden floor. Where more ornamental effects are required, tile, marble, mosaic and terrazza can be used on top of the concrete.

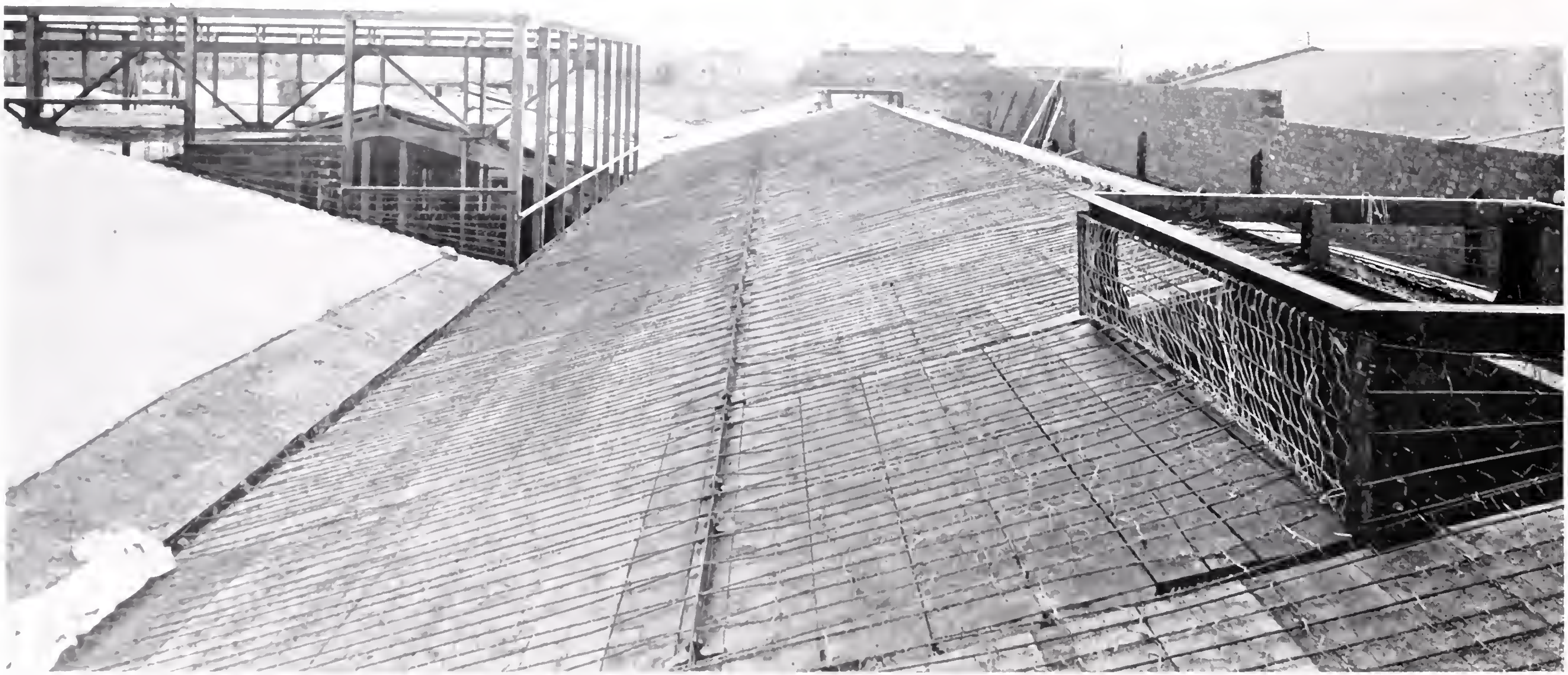
In tropical climates we advocate the omission of all wood particularly as wood is likely to be destroyed by insects.

We have lately introduced some novel features in the way of sliding windows and shutters, that are not only absolutely fire-proof but are practically indestructible and give a maximum amount of air, light, etc.

We also advocate in tropical countries, to prevent moisture rising from the ground, to have cellars to the buildings, and to water-proof these cellars, so that the cellar will be as dry and as light and clean as any other portion of the building.

We have lately finished the construction of the largest building in the City of Havana, pictures of which are shown on pages 120 to 127. This building occupies an entire block and is by far the tallest building in the city. It is constructed with hollow walls with arched floors and flat ceilings. It has a water-proof cellar—the only one in the City of Havana, and the cellar is as dry and as light as any other part in the building. This building, by actual experience, is three or four degrees cooler than any other building in Havana.

The entire interior of walls, ceilings and partitions of this building were finished at great expense in Portland cement, and the same can be washed down and cleaned without fear of injuring the construction. A number of pictures are given showing this building during construction.



[illegible] PATENT ROOF CONSTRUCTION, SHOWING WIRE WORK AND WOODEN CENTERS BEFORE CONCRETE WAS IN PLACE.

Anglo-Swiss Condensed Milk Co.'s Building, Brooklyn, N. Y.

MILLIKEN PATENT ROOF CONSTRUCTION AFTER CONCRETE IS IN PLACE.

Floor Arching, Havana Cigar Factory.

Taken during Construction, showing Method of Constructing Floor Arches with Reinforcing Metal and Flooring in Concrete.

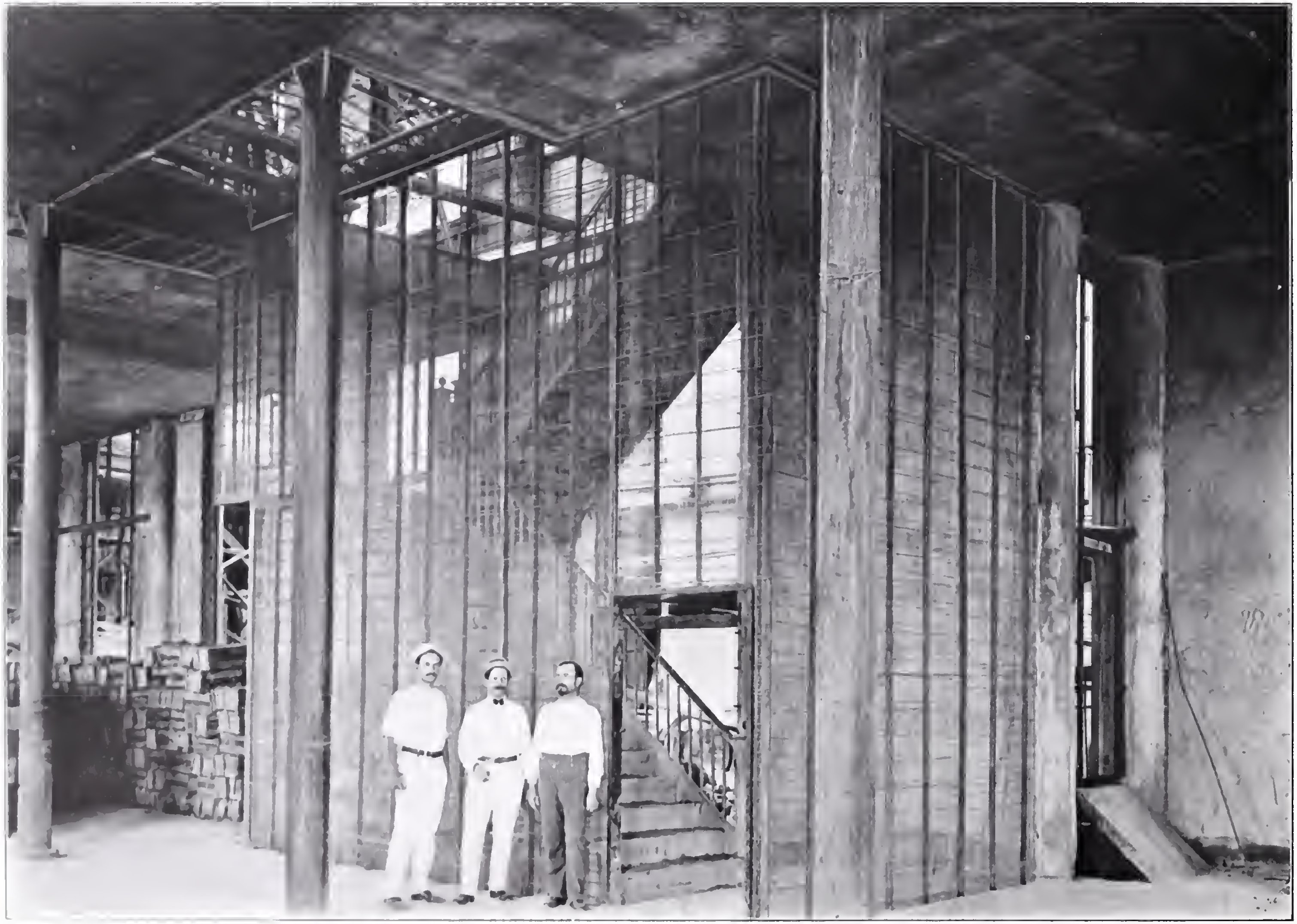
WORK DESIGNED, FURNISHED AND ERECTED BY MILLIKEN BROTHERS.

Fire-Proof Ceiling, Havana Cigar Factory.
Taken during Construction, showing part Plastered and balance with Reinforcing Metal Work.

WORK DESIGNED, FURNISHED AND ERECTED BY MILLIKEN BROTHERS.

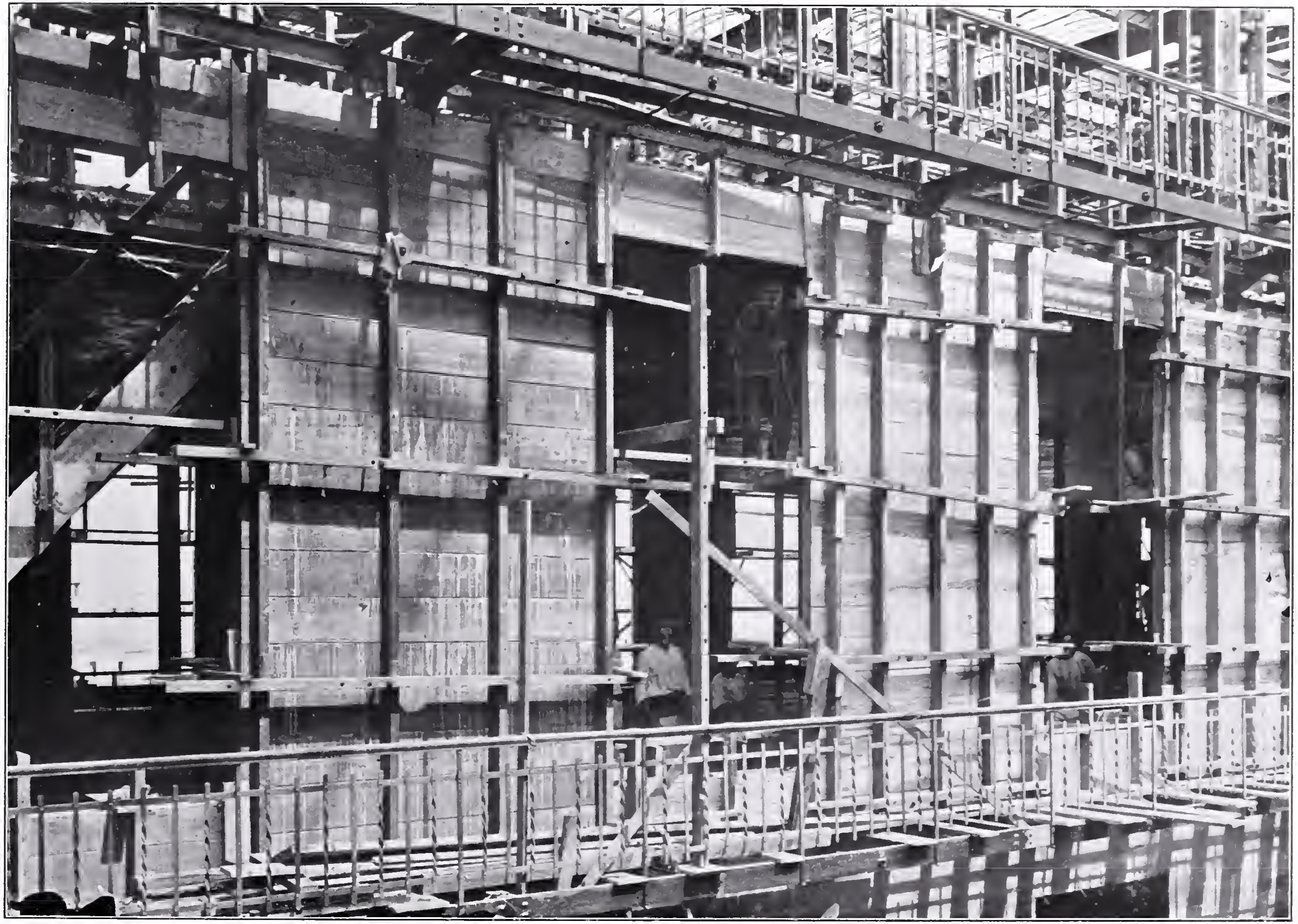
FIRE-PROOF PARTITION, HAVANA CIGAR FACTORY.

Taken during Construction, before Plastering is applied, showing Reinforcing Metal Work.



WORK DESIGNED, FURNISHED AND ERECTED BY MILLIKEN BROTHERS.

Outside Walls, Havana Cigar Factory.
Taken during Construction, showing Moulds holding Concrete Walls



WORK DESIGNED, FURNISHED AND ERECTED BY MILLIKEN BROTHERS.

Entire building designed, furnished and erected by Milliken Brothers.

INTERIOR VIEW, HAVANA CIGAR FACTORY.
Showing Finished Floor and Ceiling, with Specially Designed Windows and Blinds.

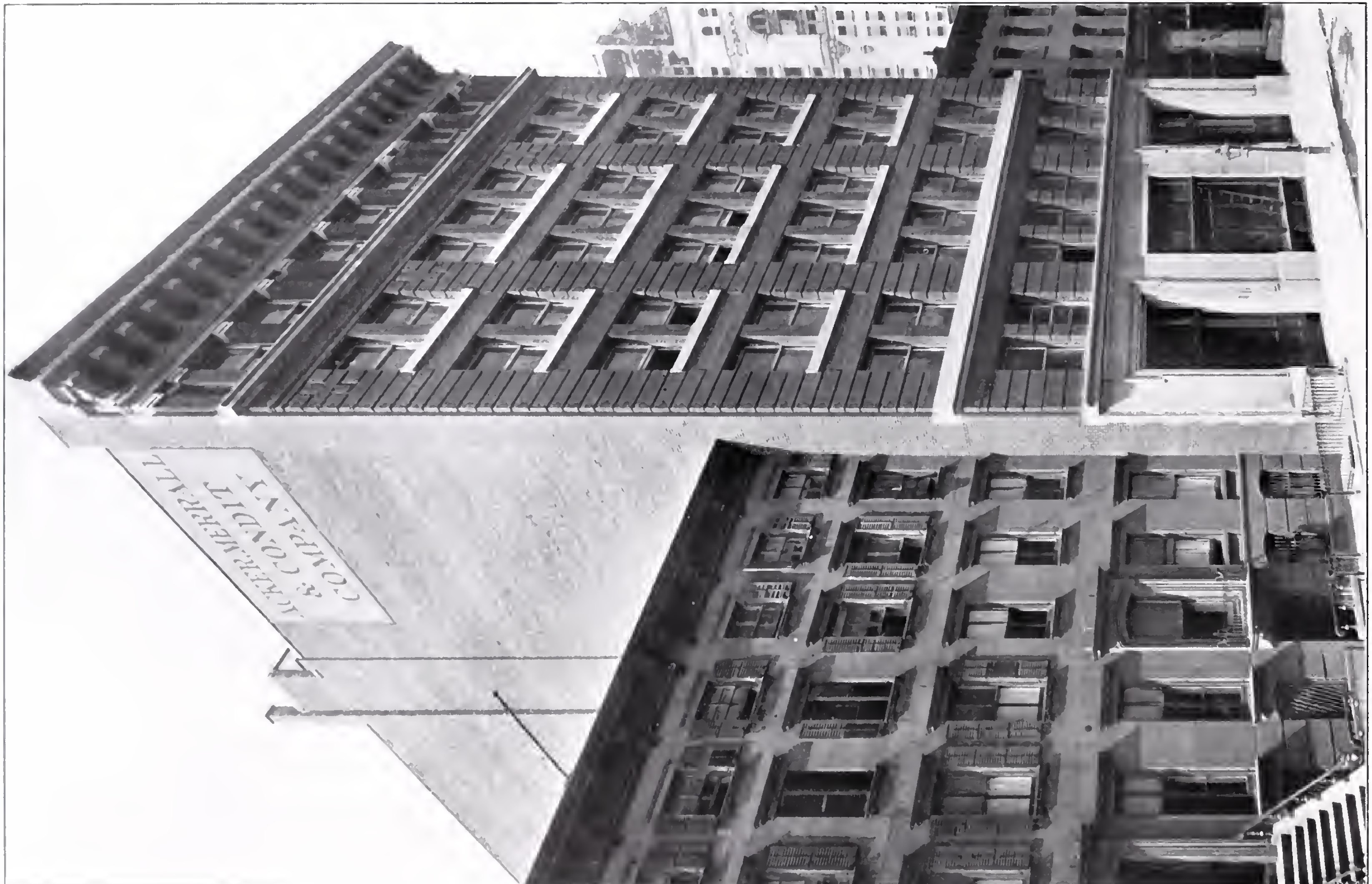
WORK DESIGNED, FURNISHED AND ERECTED BY MILLIKEN BROTHERS.

Arcade Street Front, Havana Cigar Factory. View Showing Portal Columns.

WORK DESIGNED, FURNISHED AND ERECTED BY MILLIKEN BROTHERS.

ENTIRE BUILDING DESIGNED, CONSTRUCTED AND FURNISHED COMPLETE BY MILLIKEN BROTHERS.

Acker, Merrall & Condit Company Warehouse, 43d Street, New York City.

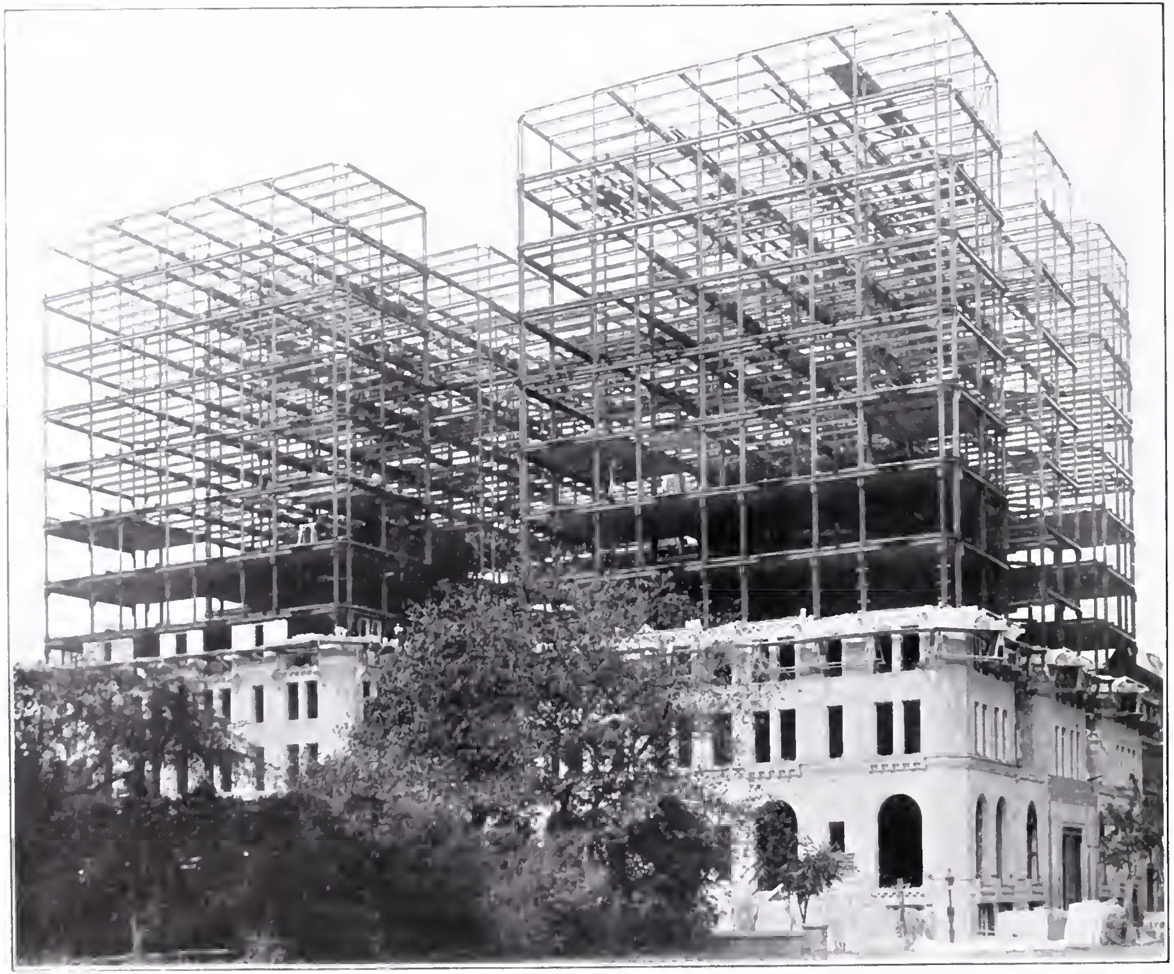


ENTIRE BUILDING DESIGNED, CONSTRUCTED AND FURNISHED COMPLETE BY MILLIKEN BROTHERS.

Siegel-Cooper Building, 18th and 19th Streets and Sixth Avenue, New York City.

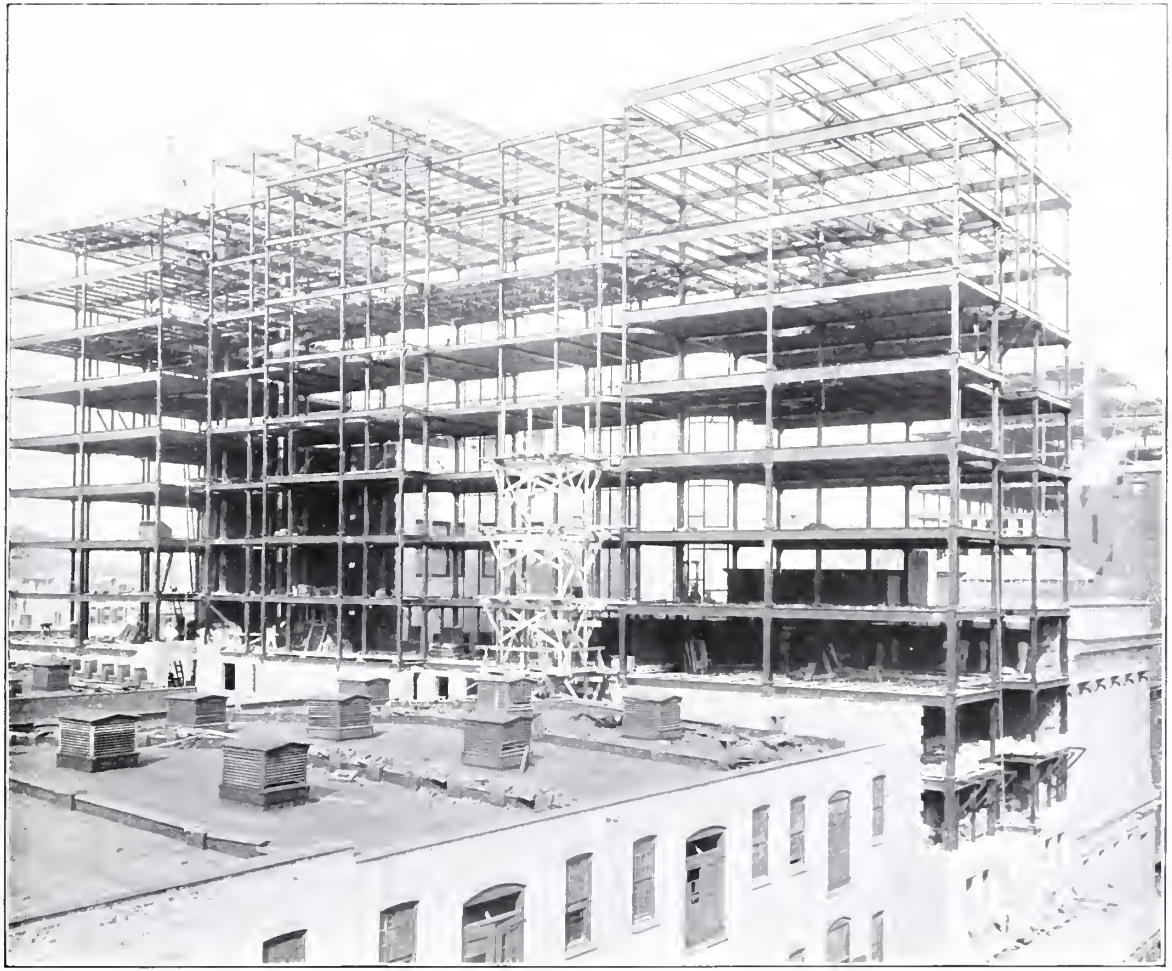
IRON AND STEEL WORK FURNISHED AND ERECTED BY MILLIKEN BROTHERS.

HOTEL MAJESTIC, 72D STREET AND CENTRAL PARK WEST, NEW YORK CITY.



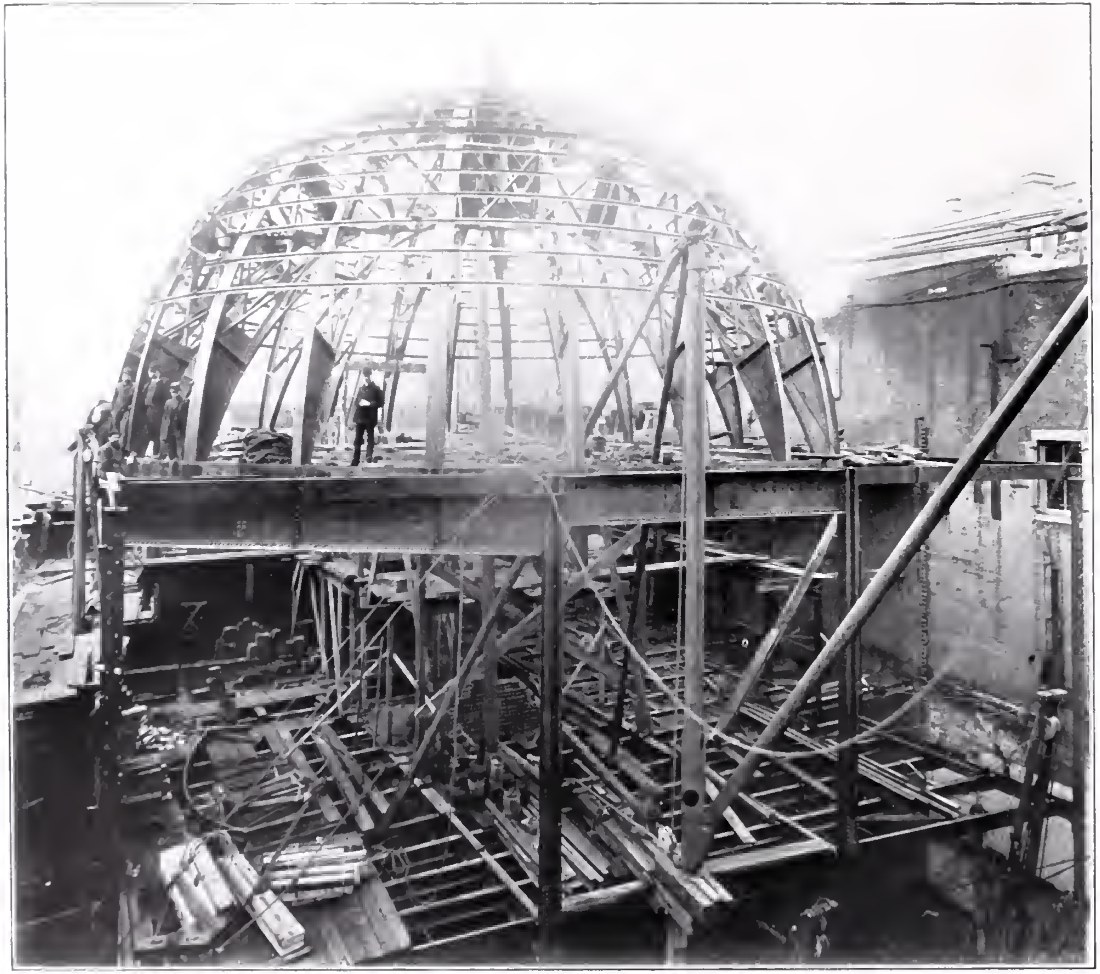
STEEL WORK DESIGNED AND FURNISHED BY MILLIKEN BROTHERS.

HOTEL ROYALTON, 43D STREET NEAR SIXTH AVENUE, NEW YORK CITY.



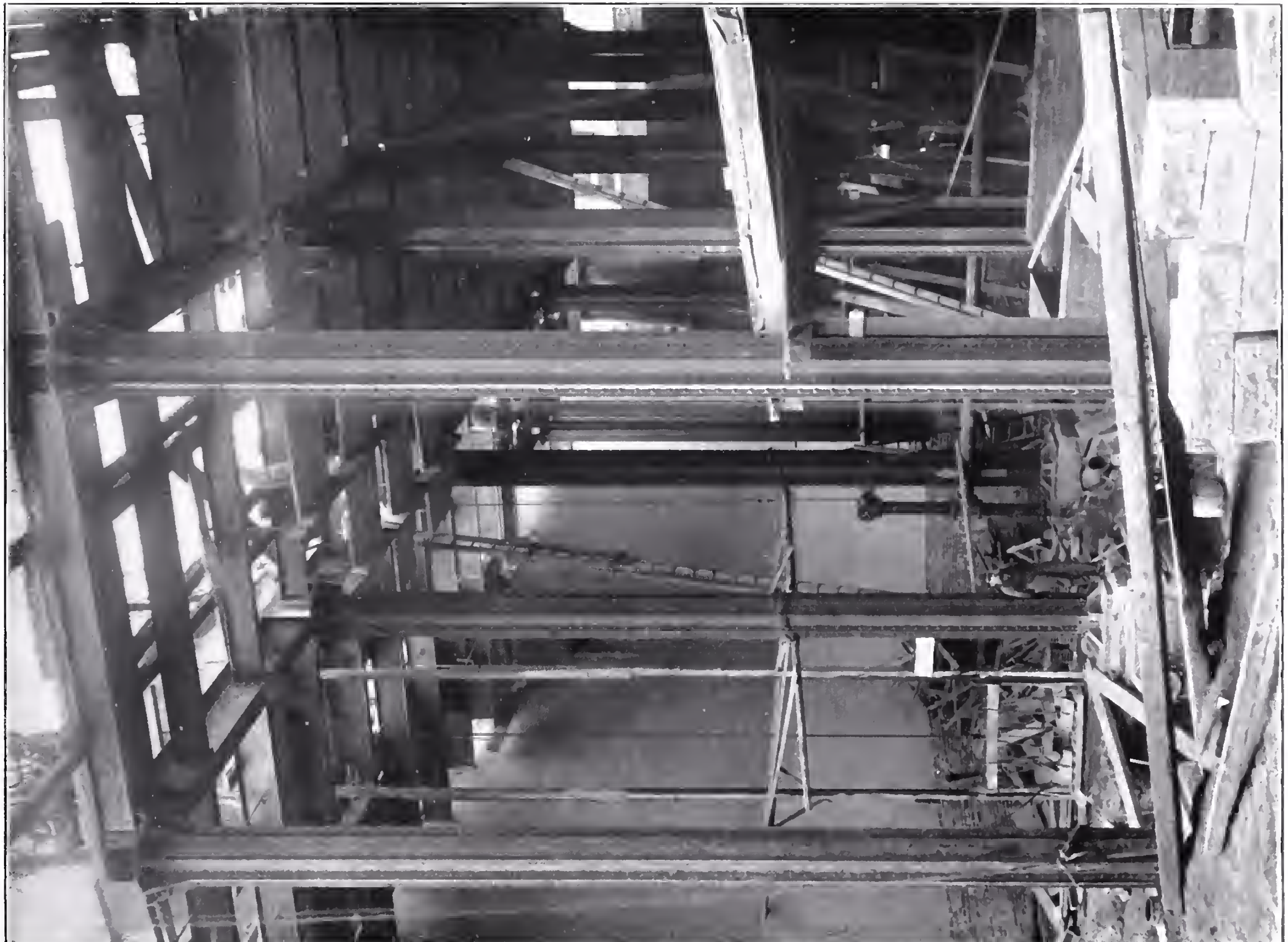
STEEL WORK DESIGNED, FURNISHED AND ERECTED BY MILLIKEN BROTHERS.

Dome of New York Clearing House, New York City.



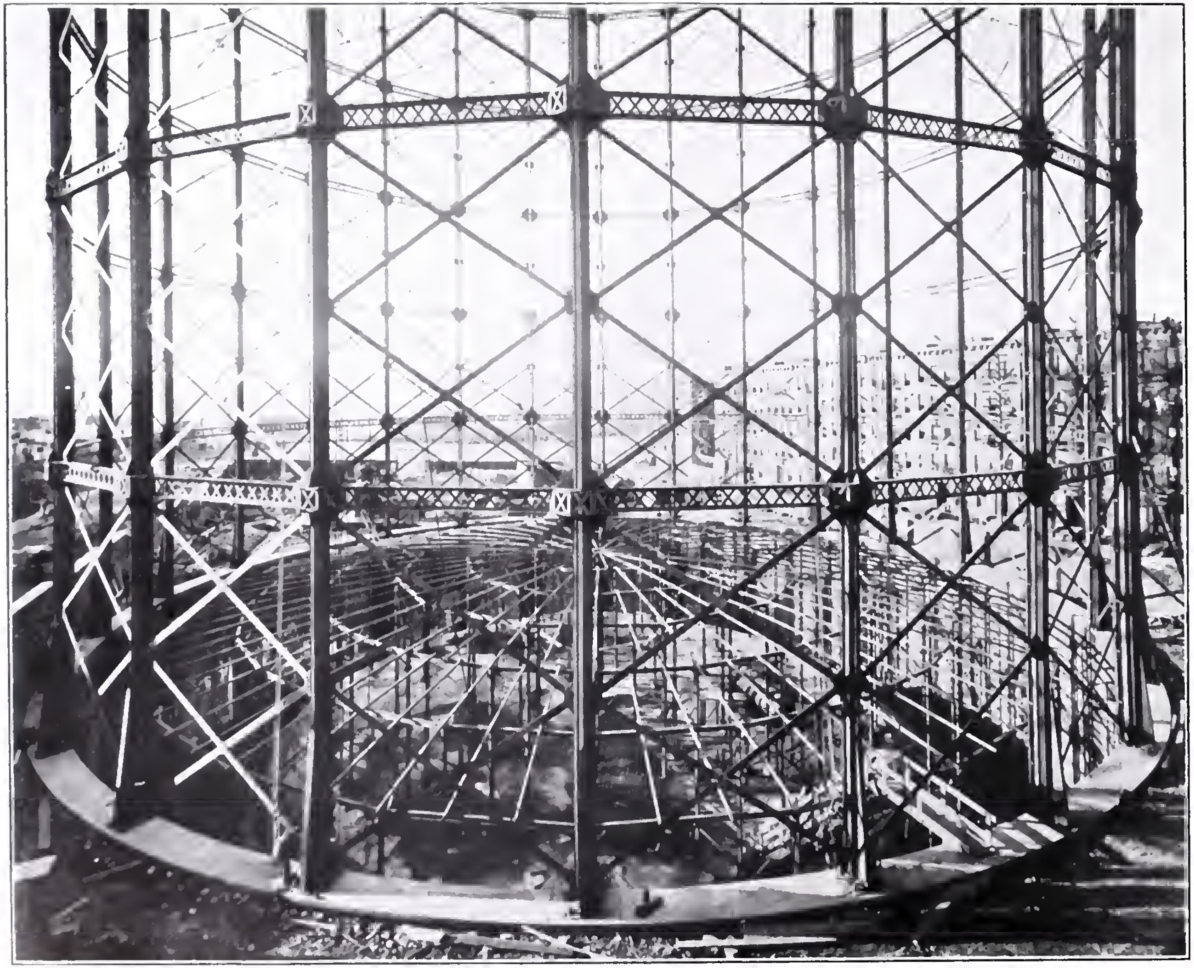
STEEL WORK FURNISHED AND ERECTED BY MILLIKEN BROTHERS.

Pearl Street Station, Edison Electric Ill. Co., New York City.



STEEL WORK DESIGNED AND FURNISHED BY MILLIKEN BROTHERS.

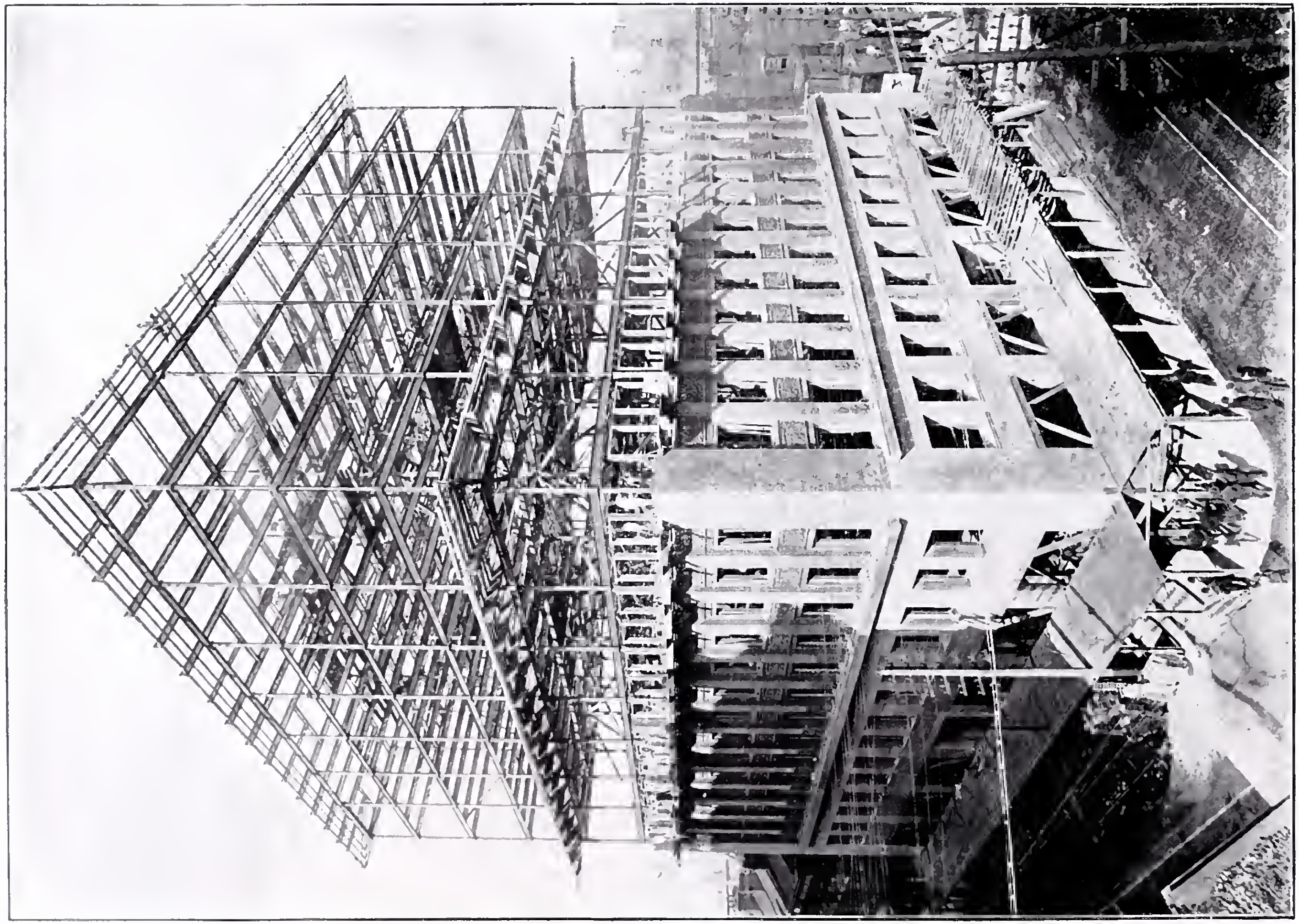
Gas Holder Guide Frame, New York City.



STEEL WORK FURNISHED AND ERECTED BY MILLIKEN BROTHERS.

R. Boker & Co. Building, Mexico City, Mexico.

STEEL WORK FURNISHED AND ERECTED BY MILLIKEN BROTHERS.



PHŒNIX COLUMNS SHOWING SKELETON CONSTRUCTION.

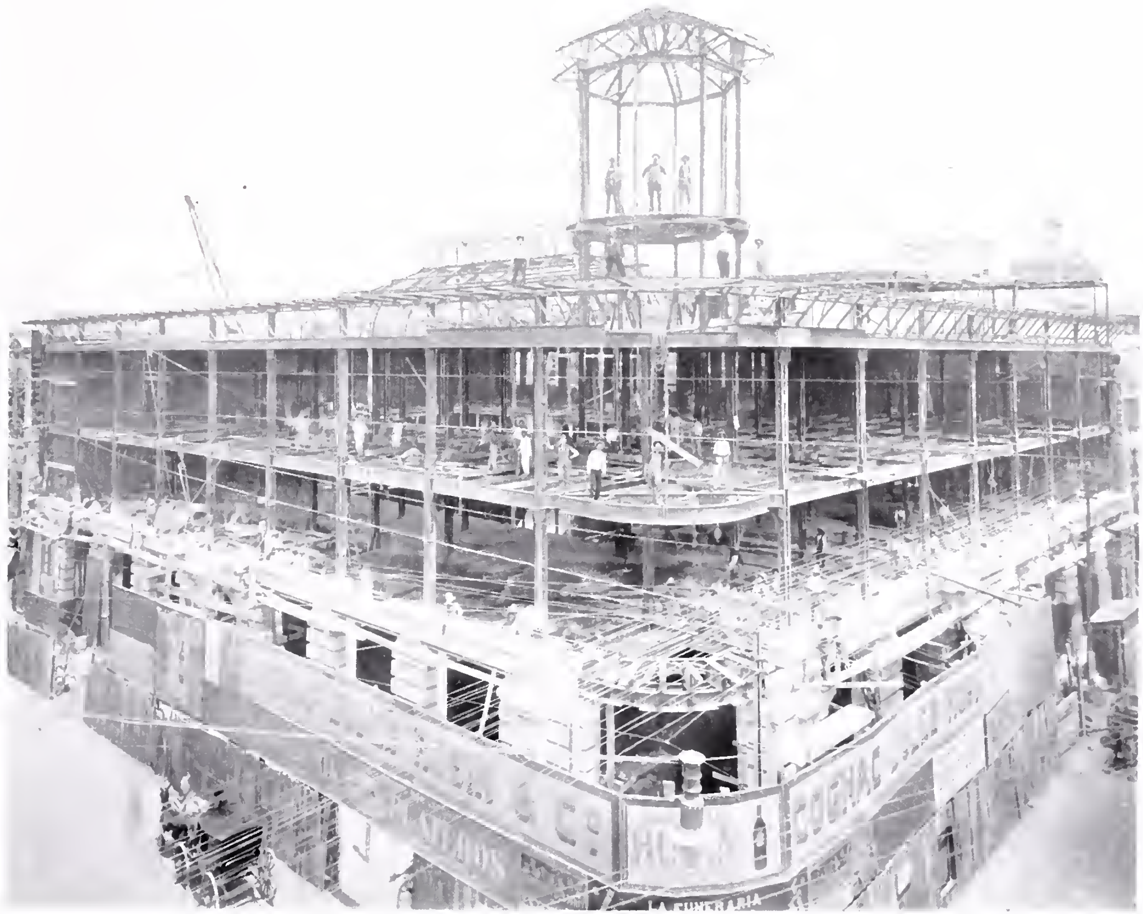
Roof of Private Dwelling, H. O. Havemeyer, New York City.

IRON WORK DESIGNED AND CONTRACTED FOR BY MILLIKEN BROTHERS.

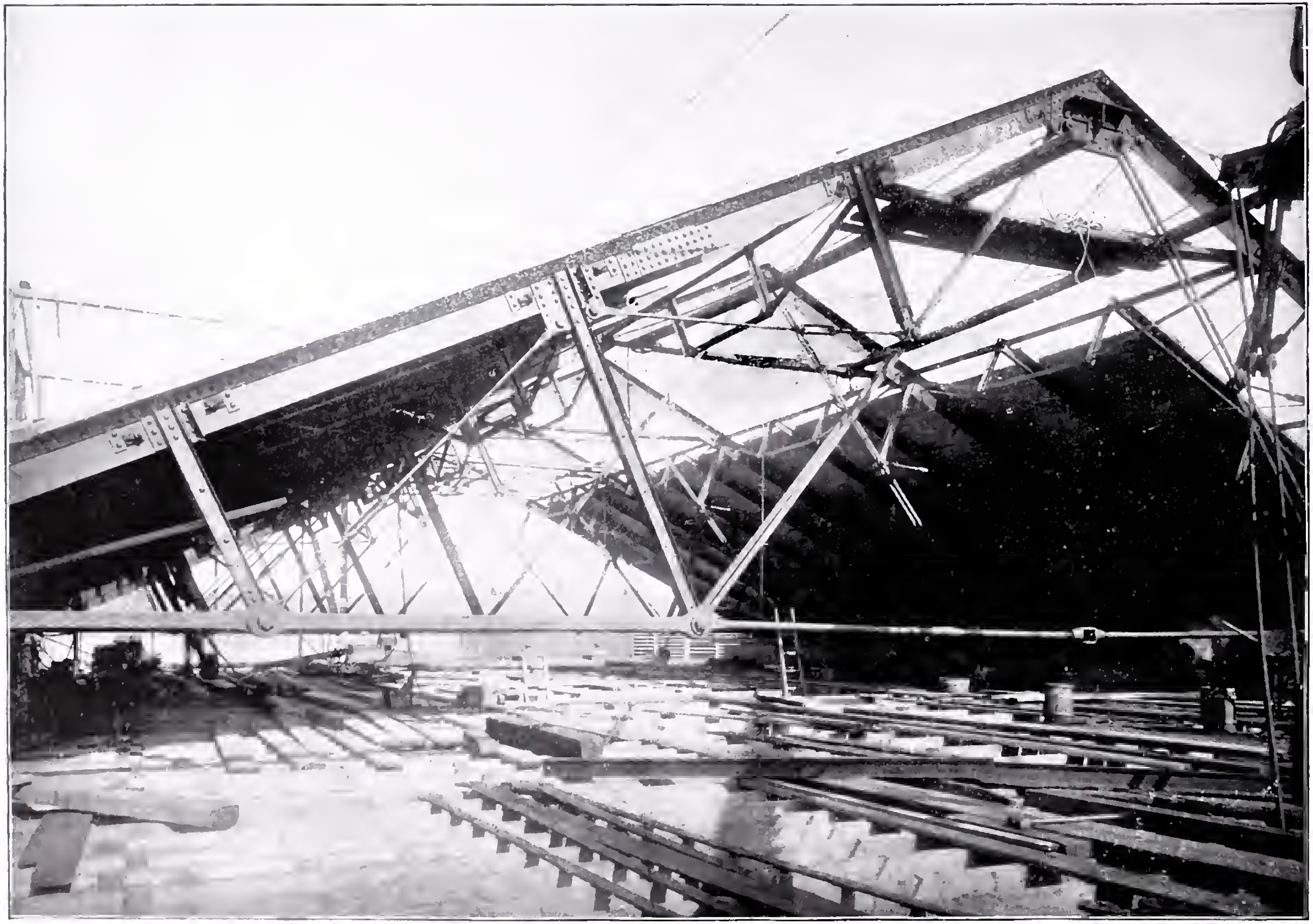
R. G. Dun Building, Reade Street and Broadway, New York City.

STEEL WORK FURNISHED AND ERECTED BY MILLIKEN BROTHERS.

R. Boker & Co. Warehouse, Mexico City, Mexico.

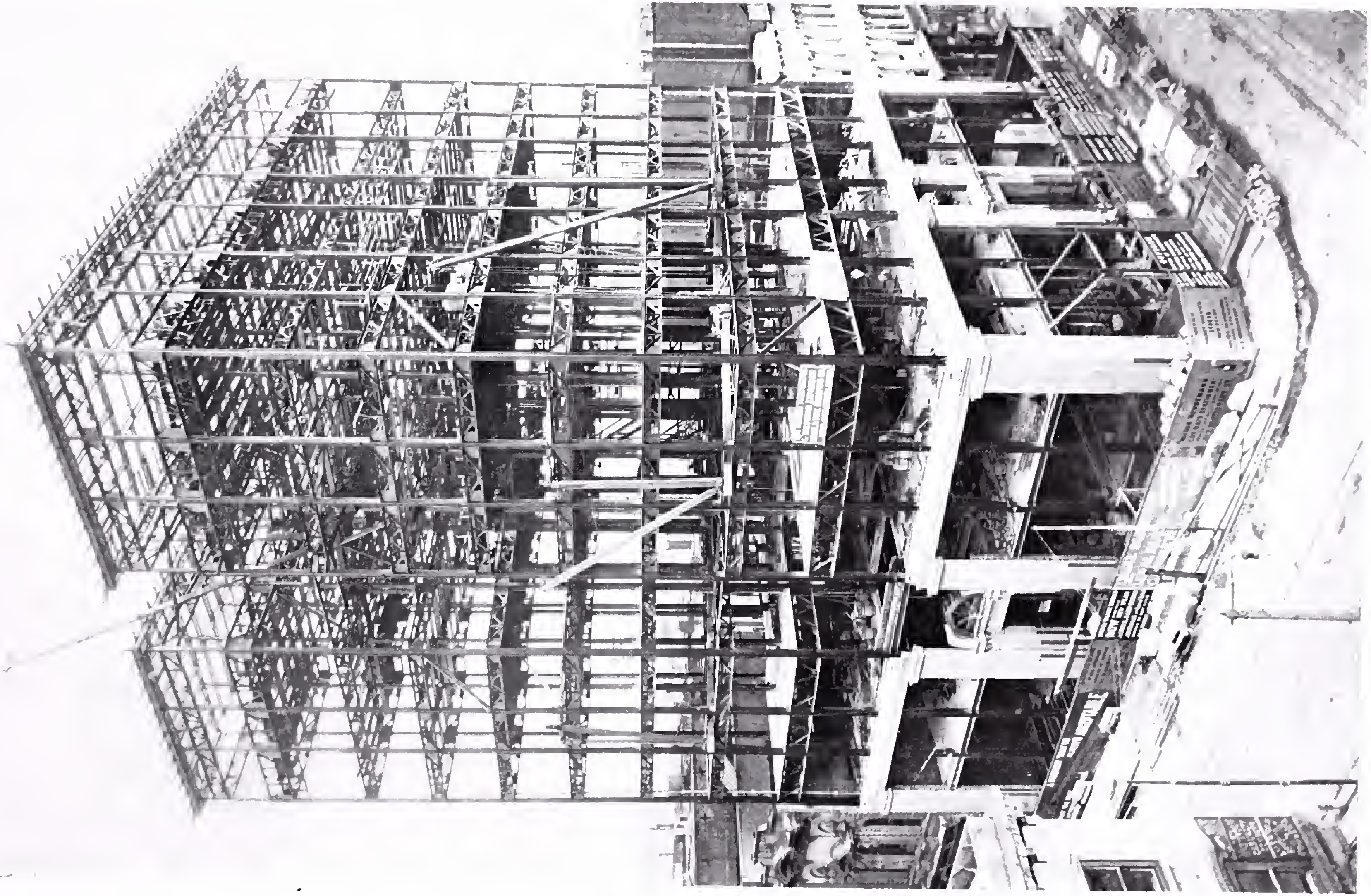


STEEL WORK FURNISHED AND ERECTED BY MILLIKEN BROTHERS.

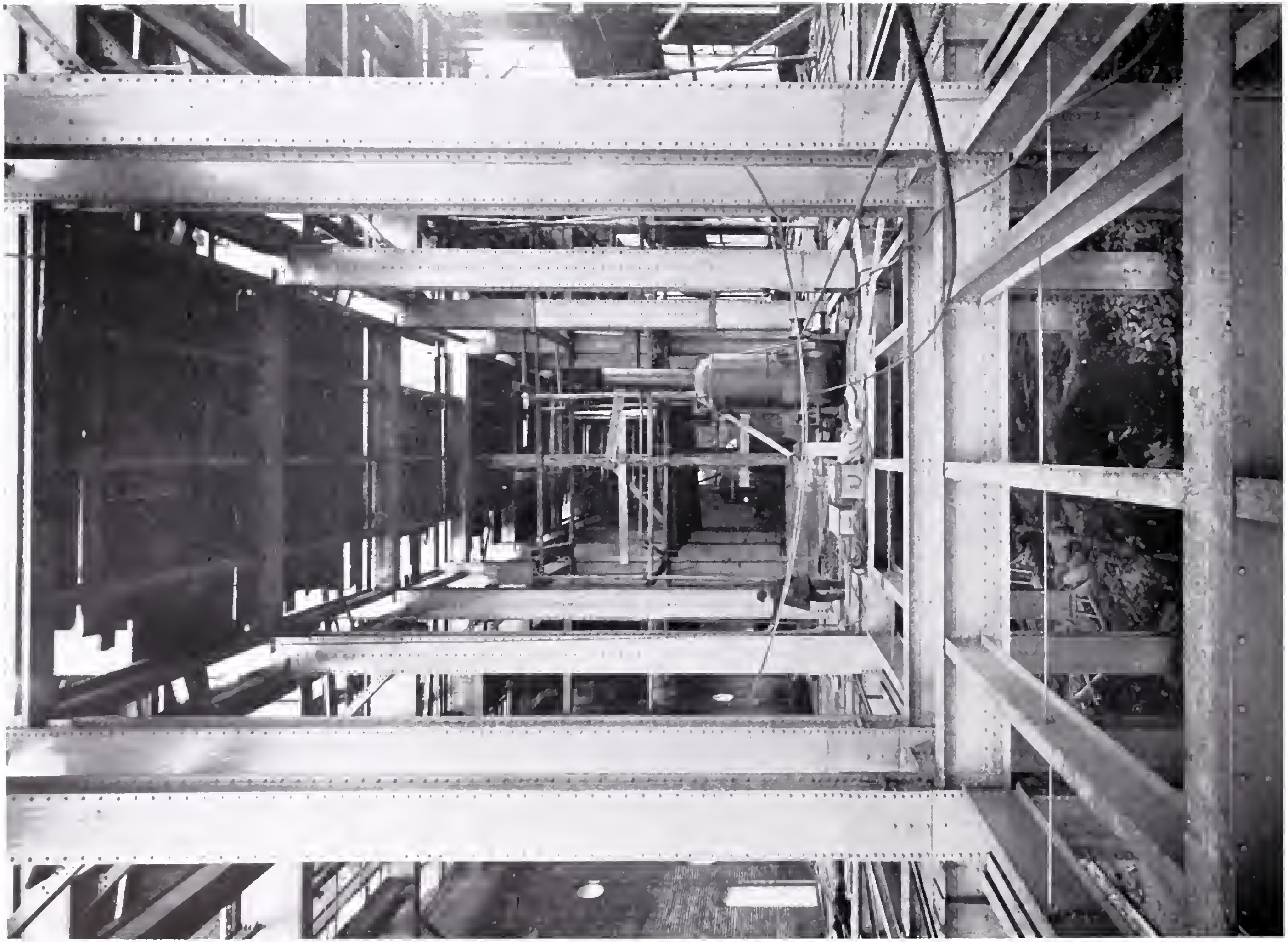


IRON WORK DESIGNED, FURNISHED AND ERECTED BY MILLIKEN BROTHERS.

HAYWARD BUILDING, SAN FRANCISCO, CALIFORNIA.



STEEL WORK DESIGNED, FURNISHED AND ERECTED BY MILLIKEN BROTHERS.

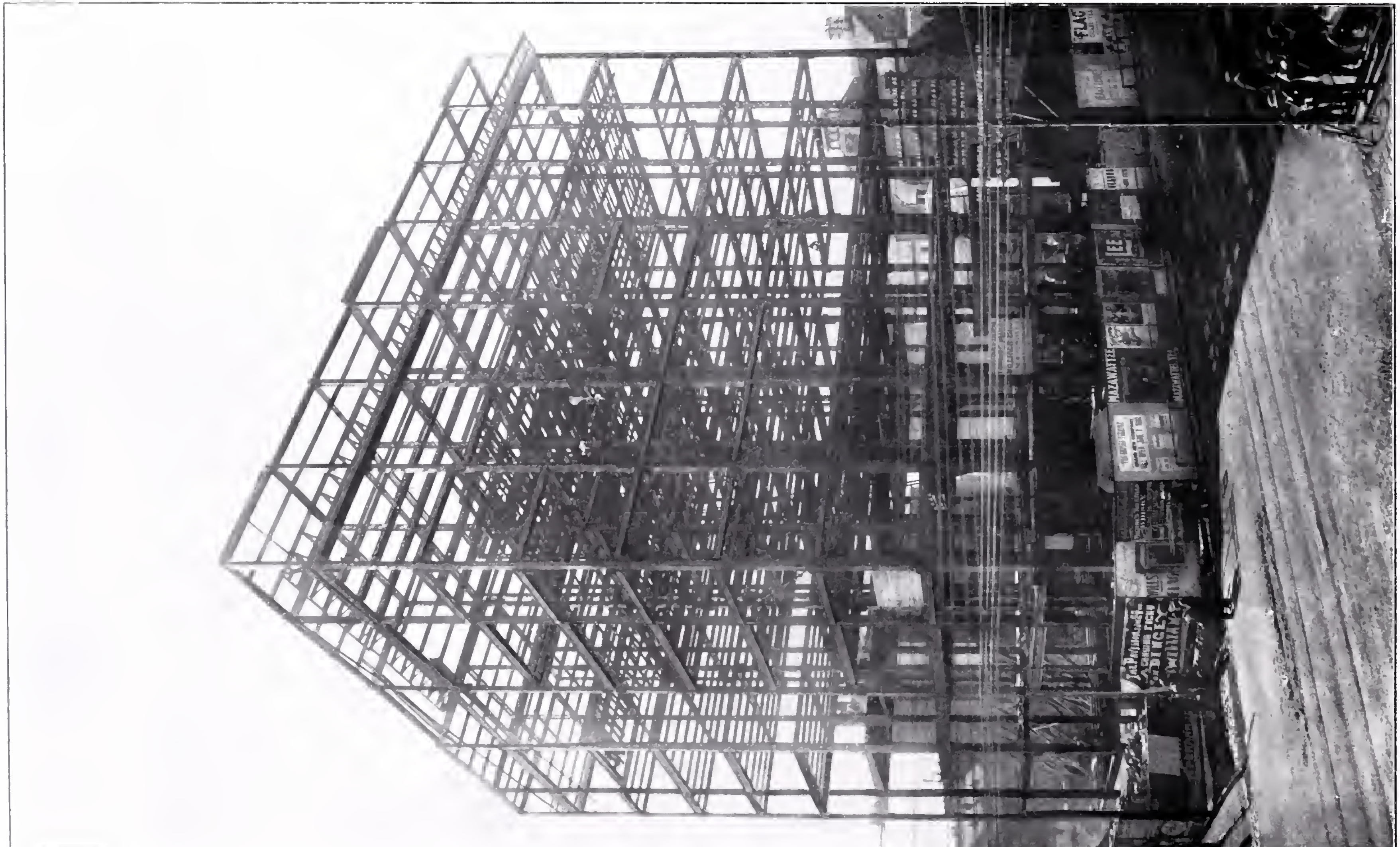


STEEL WORK DESIGNED, FURNISHED AND ERECTED BY MILLIKEN BROTHERS.

Store Building, Port of Spain, Trinidad.

STEEL WORK DESIGNED AND FURNISHED BY MILLIKEN BROTHERS.

Eckstein Building, Johannesburg, South Africa.

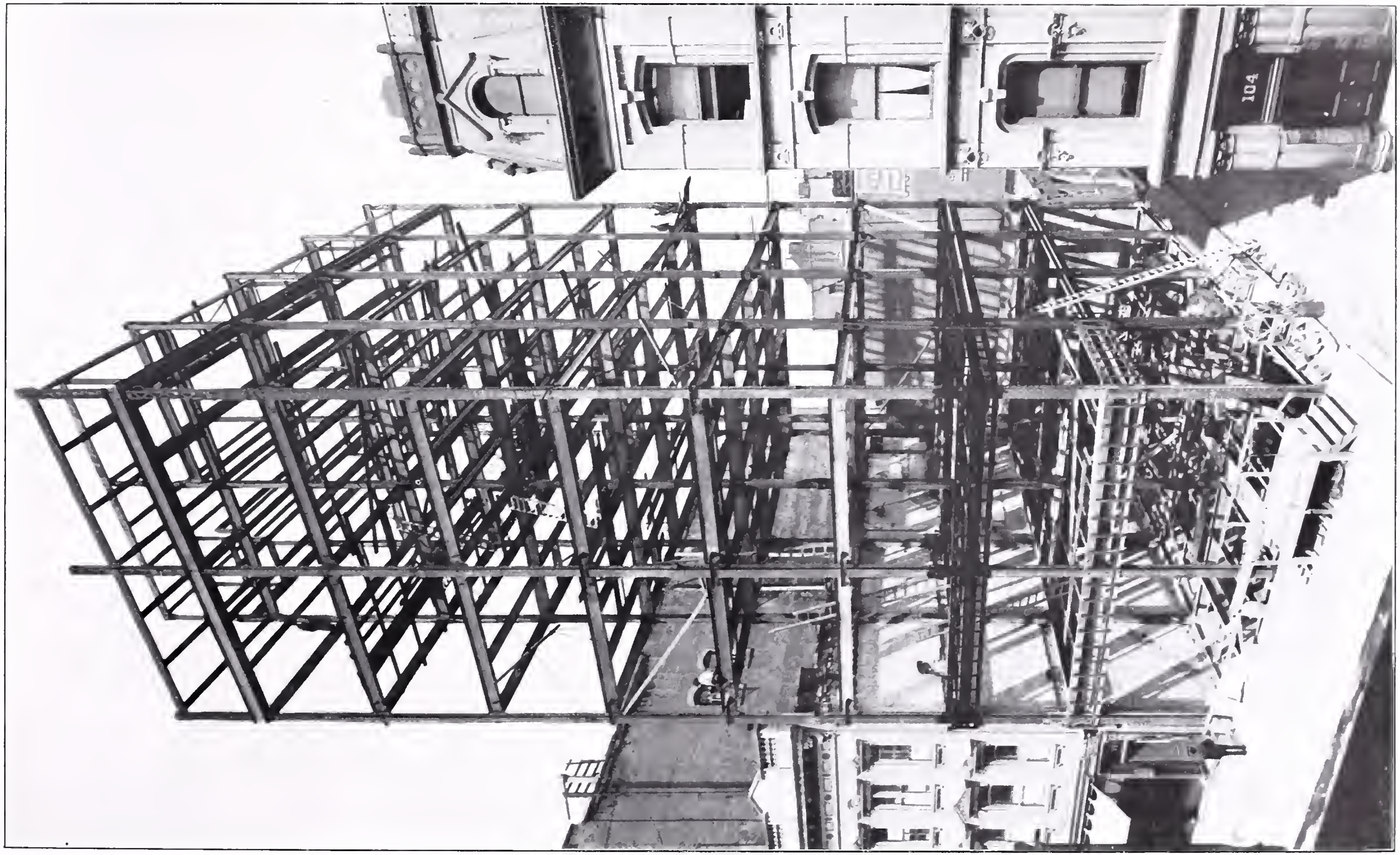


STEEL WORK DESIGNED, FURNISHED AND ERECTED BY MILLIKEN BROTHERS.

STEEL WORK DESIGNED, FURNISHED AND ERECTED BY MILLIKEN BROTHERS.

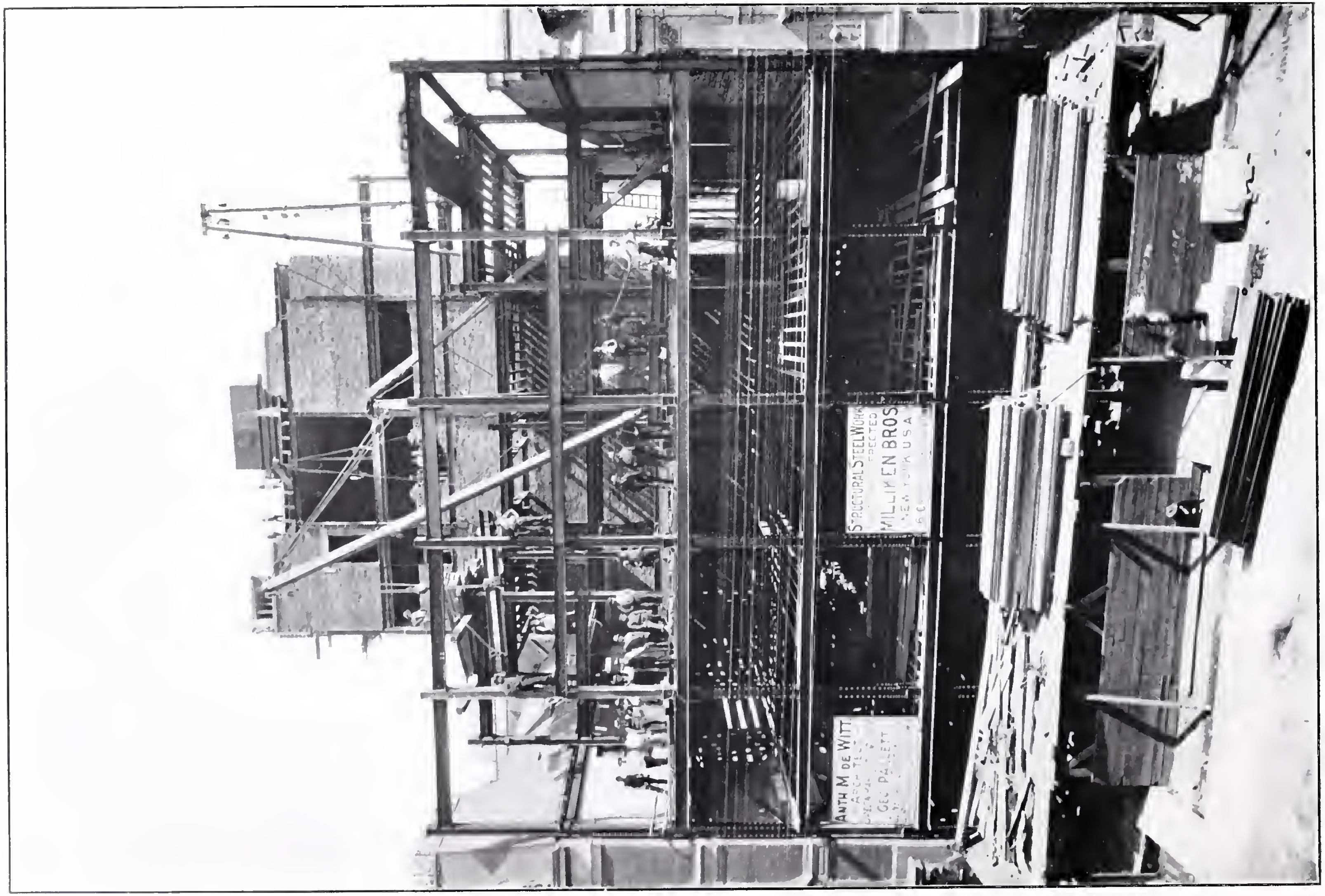
Aronson Building, San Francisco, California.

STEEL WORK FURNISHED BY MILLIKEN BROTHERS.



STEEL WORK FURNISHED BY MILLIKEN BROTHERS.

W. J. Jagger & Company's Building, Cape Town, South Africa.



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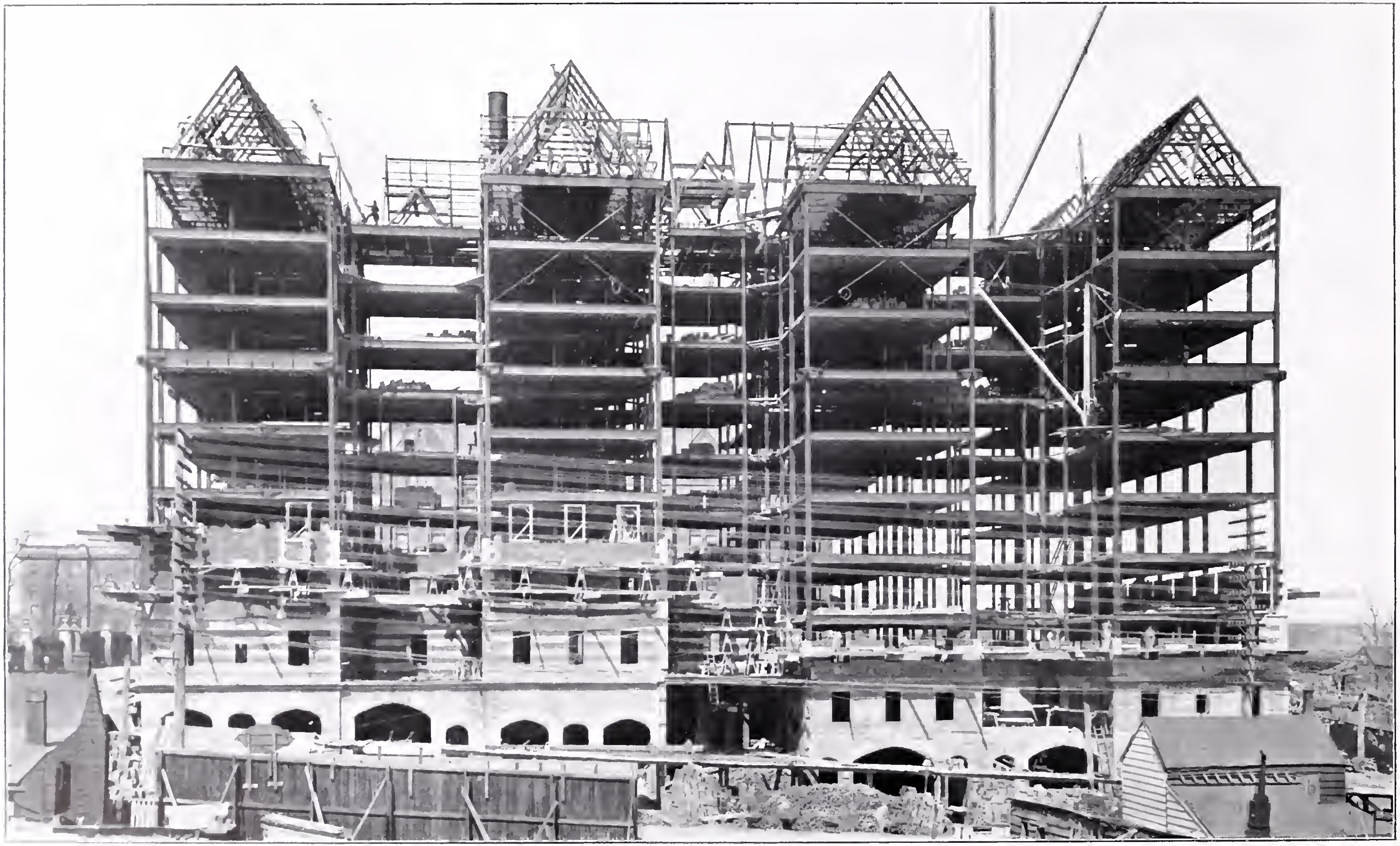
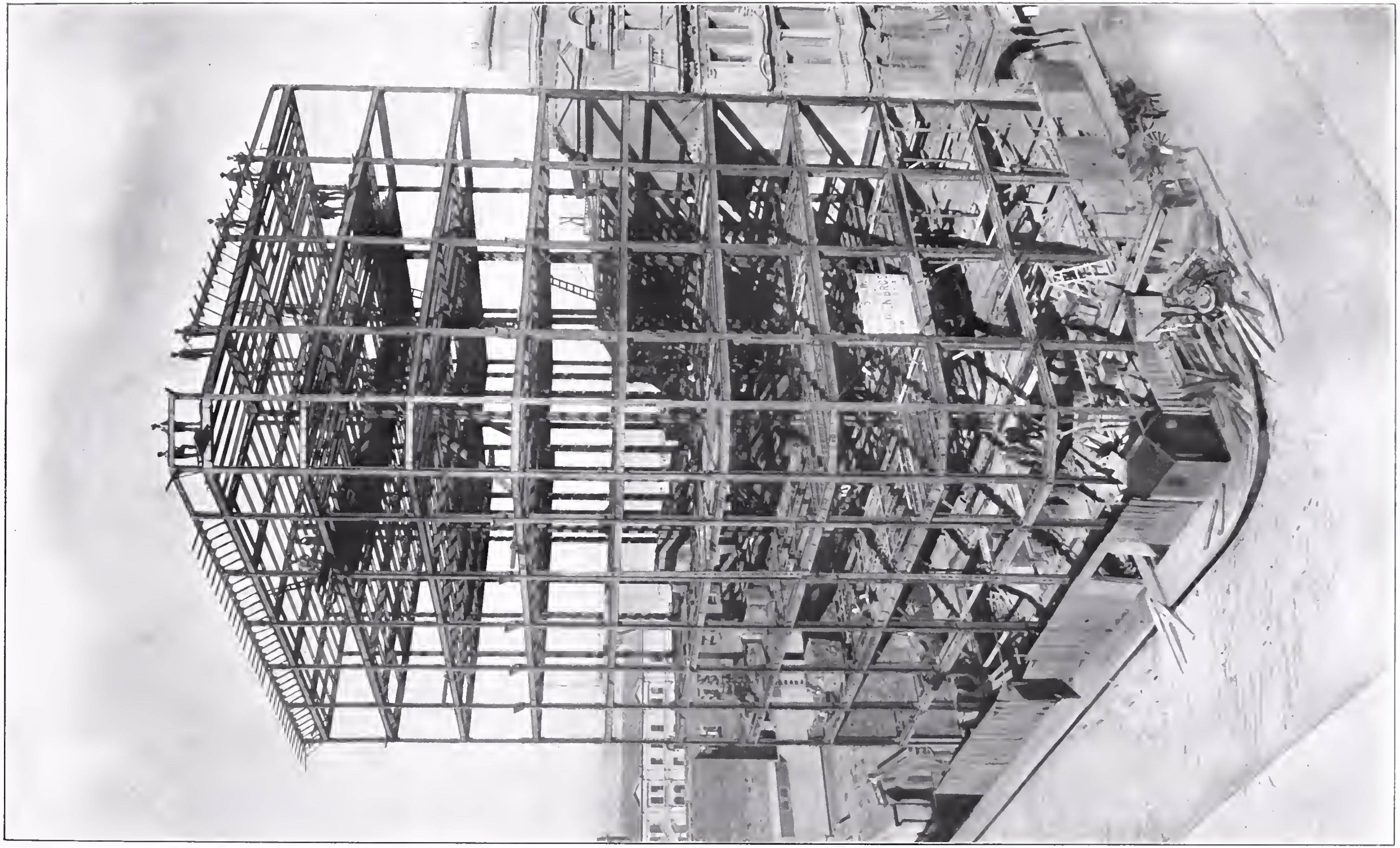
STEEL WORK FURNISHED AND ERECTED BY MILLIKEN BROTHERS.



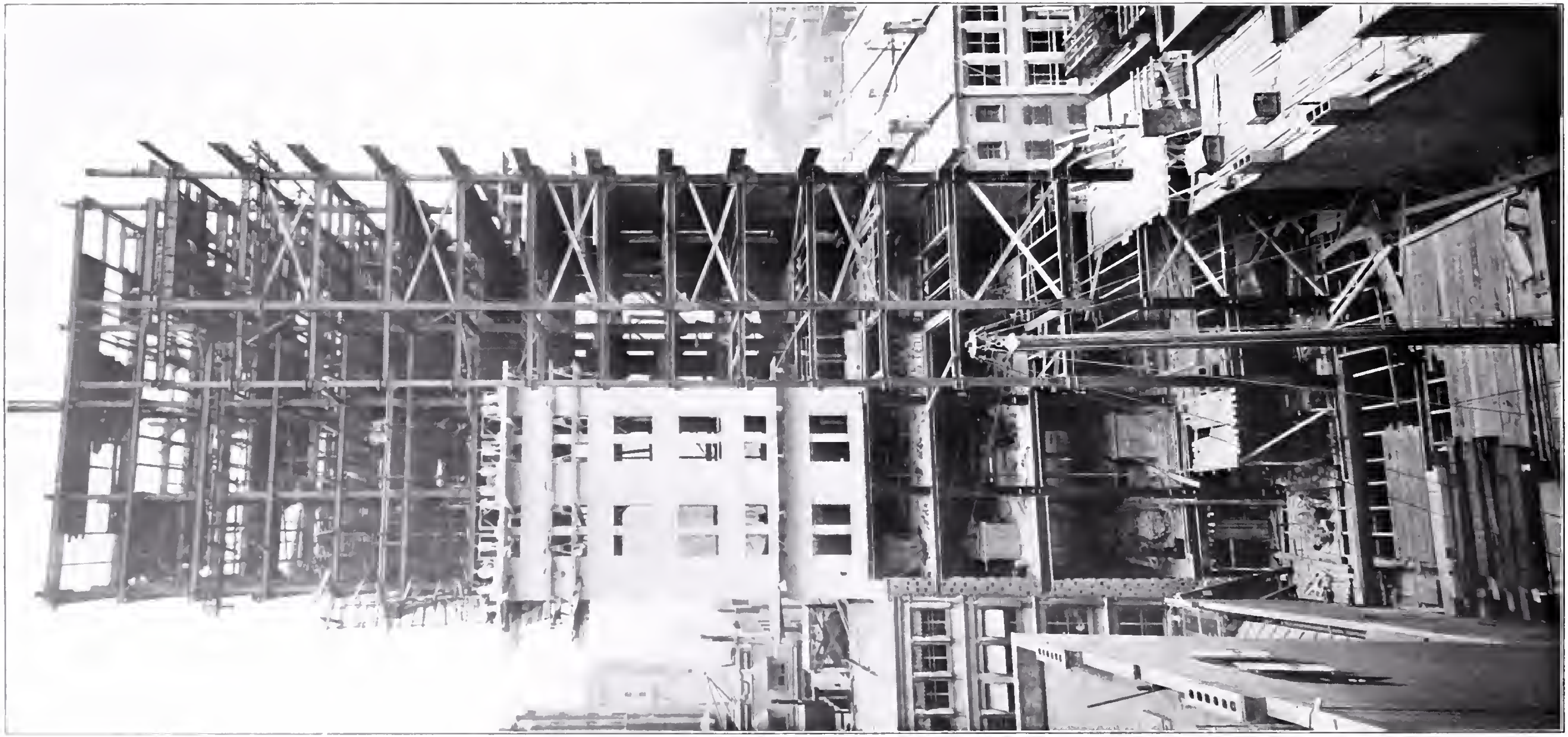
STEEL WORK DESIGNED, FURNISHED AND ERECTED BY MILLIKEN BROTHERS.

Garlick Building, Cape Town, South Africa.



STEEL WORK DESIGNED, FURNISHED AND ERECTED BY MILLIKEN BROTHERS.

Twenty-Six Story Office Building for The International Banking Corporation, No. 60-62 Wall Street, New York City.



STEEL WORK FURNISHED AND ERECTED BY MILLIKEN BROTHERS.

MANUFACTURING BUILDINGS, SHEDS, MARKET BUILDINGS, CEMENT MANUFACTORIES, ETC.

Owing to the low price of steel work it has been proven that roofs, and buildings in general can be constructed in nearly all cases as cheaply in steel as they can in wood, and have the additional advantages of being fireproof and much more durable. Probably the simplest form of this class of construction is passageways shown on Figure 2. These are used for access from one building to another, or on docks or any other place where a covered passageway is required to protect either persons or goods from the weather. The roof is usually covered with corrugated galvanized sheet iron.

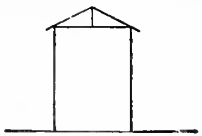


Figure 2.

Another simple form of construction is a shed over a sidewalk, as shown in Figure 3, which reaches from a building to the curb and is also used for the protection of persons and goods.

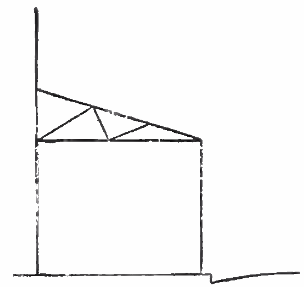


Figure 3.

A larger form of construction is for the roofs of buildings which have brick or stone walls as shown in Figure 4.

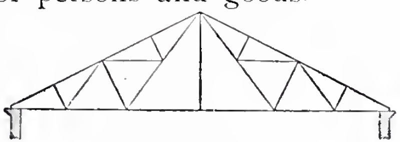


Figure 4.

In buildings in which the walls are not of brick or stone but composed

of iron, it is often advisable to have projecting awnings, as shown in Figure 5, to protect the inside of the building from the weather, in cases where there are openings or doors in sides of building, especially when the main roof of the building is at any considerable height. The roofs in these cases are usually covered with corrugated galvanized sheet iron.

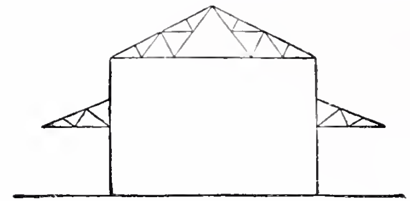


FIGURE 5.

The most complicated form in which steel is used for roof trusses is shown on Figure 6. Buildings of this class are generally used for Armories, Drill Halls, Railroad Depots and Exhibition Halls, or places where a large amount of space is required, with height between the floor and the truss, and at the same time unobstructed by any columns or supports. The form of truss shown in this Figure is known as the Three Hinge Arch Truss. The covering of these roofs is generally made of wood on which is laid tin, copper or some other weather protecting material.

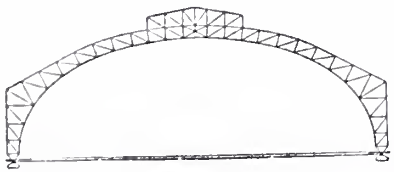


FIGURE 6.

Plate No. 43 shows a very economical and efficient design for a Railroad Station, which gives plenty of light and air, at the same time protecting the passengers and the cars from the weather. Many other designs could be given arranging for either more or less tracks than are shown on this plate.

We have made a specialty of designing and building, for a number of years past, machine shops, foundries and shops for the manufacture of all classes of goods. Plate No. 46 shows the design for a shop where heavy material is to be manufactured. The central or main span of the roof covers a traveling crane which is used for the moving of heavy material. In this country these cranes are universally moved either by hand for small manufactories, or in the larger works by electric power, which gives absolute and quick movement, and these cranes are made to lift almost any load. Many are

now in use which lift 100 tons (91,000 kilos.) We are prepared to include in estimates for this class of work the cranes complete with all their mechanism. The crane is usually operated by one man who sits in a cage directly under the crane girders and operates the crane by means of levers and switches.

The side walls of these manufacturing buildings are often built of brick or stone as shown on Plate No. 47, but in many other instances we construct the sides entirely of corrugated galvanized sheet iron. The two leantos on either side of the main span are usually for the manufacture of lighter articles than those handled under the main span, and in some cases we design the buildings with an additional floor making two stories of this part of the building. For the easy movement of the goods under these leantos we usually furnish hand trolleys, by which the load can be raised or lowered from the floor by differential blocks and moved along the trolleys by hand, thus saving the labor of lifting them bodily and transporting them on trucks.

Several pictures appear in this catalogue of manufacturing buildings of this class, with both the single and the double floor underneath the leantos.

We have also given a great deal of attention to the designing and building of market buildings, especially for countries in warm climates. A view of such a market is shown on Plate No. 48. The frame of the building is constructed entirely of steel from the foundations up. The roof is covered with corrugated galvanized sheet iron, and the sides of the building are constructed of open iron work, with a panel of sheet iron work near the ground. The particular objects that we have in view in making the designs are perfect ventilation, and each part designed so that the market can be easily and quickly cleaned and all parts are arranged so that neither dirt nor refuse can accumulate and decay and thus cause trouble.

In furnishing this work we are prepared to furnish the construction of the stalls themselves for the sale of the goods together with the counters, cash drawers, etc. Also fountains, clocks and the other ornamental

and useful accessories that go with such a building. We are also prepared to furnish elevated water tanks so that water can always be obtainable to completely wash the market each day, all of which is fully explained later on. Plate No. 49 shows a design for a building to be used for various purposes where it is desirable to seat a large number of people and it is arranged so that each person will have a perfect view of the stage or centre of the building as the case may be. This form of building is so arranged that it has the advantage of being particularly adapted for the use of assemblies, conventions, theatre performances, circuses, athletic games, bull fights, etc. The stage is usually located at one end of the building but is so constructed that it can be removed when desired. The centre of the building or main floor is arranged with seats when the performance is taking place on the stage, but when used for a circus these seats are removed. At least two or more balconies of seats can be arranged around the sides of the building. In front of these seats, stalls for the accommodation of a number of people in one party can be arranged. Access to any part of the building can be had under these balconies without crossing the arena of the building. In case it is not possible to get light from the sides of the building, owing to adjoining buildings, ample light can be afforded from the roof.

We have lately made a specialty of designing and constructing buildings for the manufacture of cement. On pages 235, 236, and 259, 260 will be found views of some of these buildings. We wish to call your particular attention to the part of this Catalogue devoted to the subject of tanks and the photographs shown in connection with this work on page 255. Nearly all the manufactories of cement require large tanks for the storage of rocks, cinders, ground cement, coal, etc., all of which class of work is manufactured by us.

Plate No. 46.

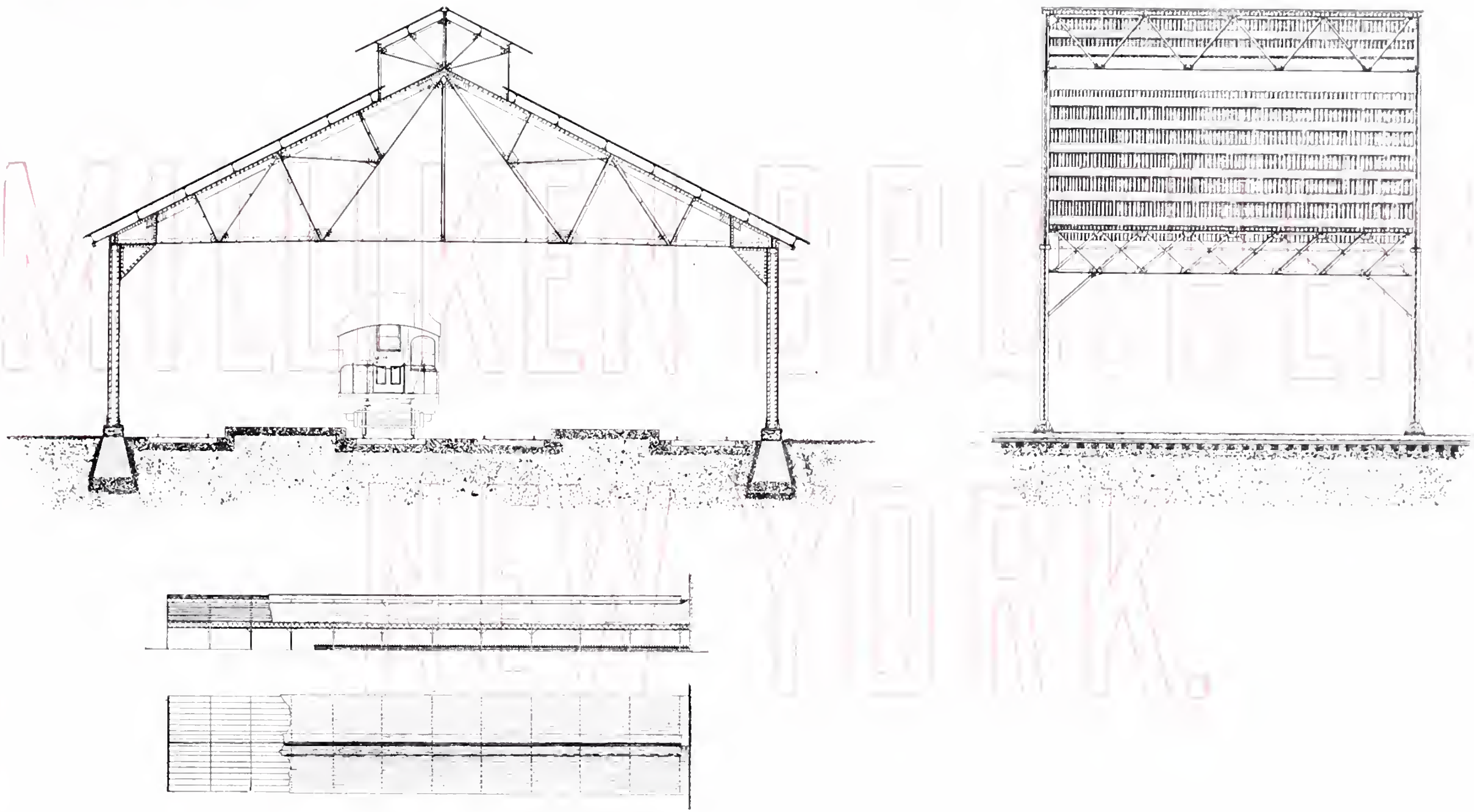


Plate No. 47.

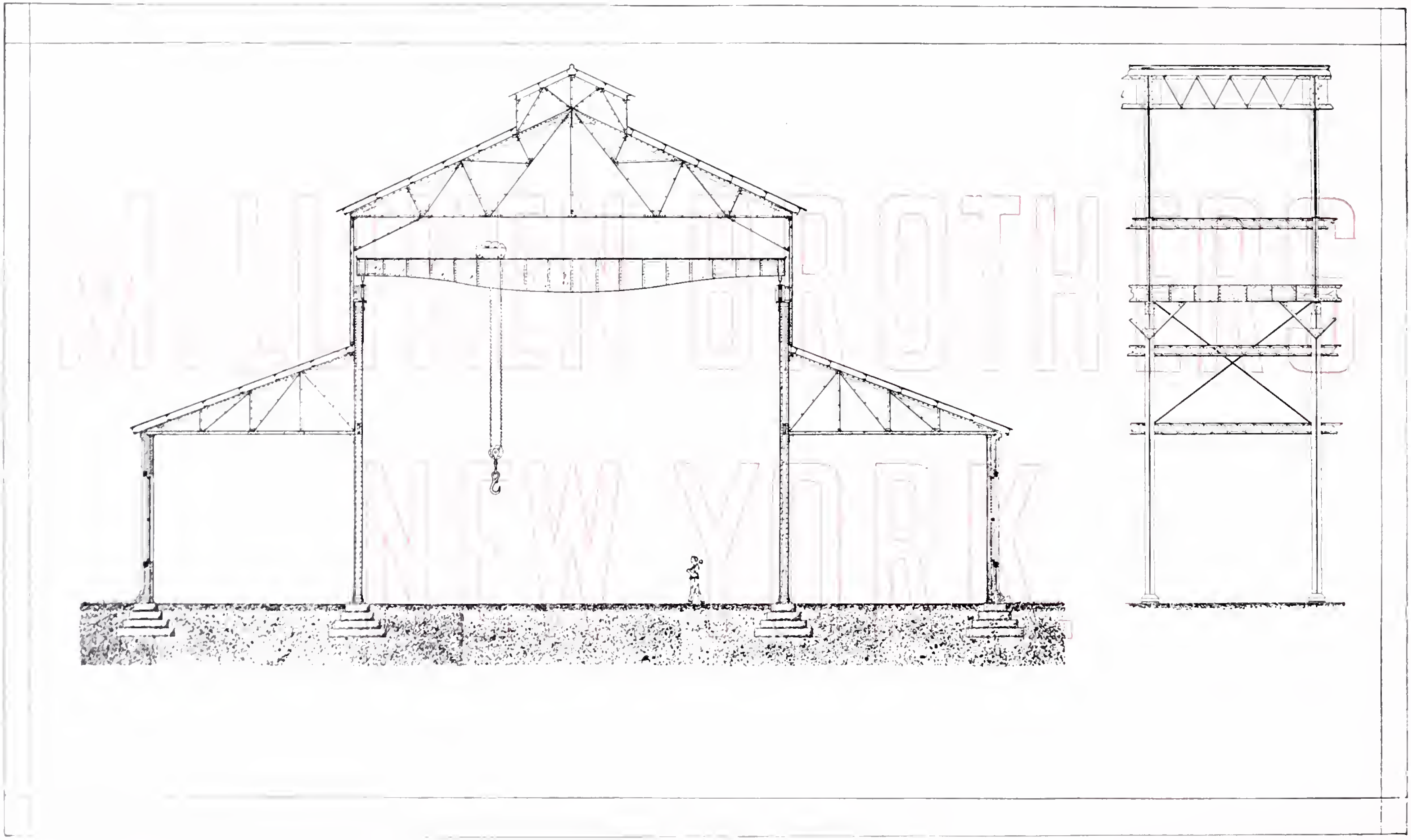


Plate No. 48.

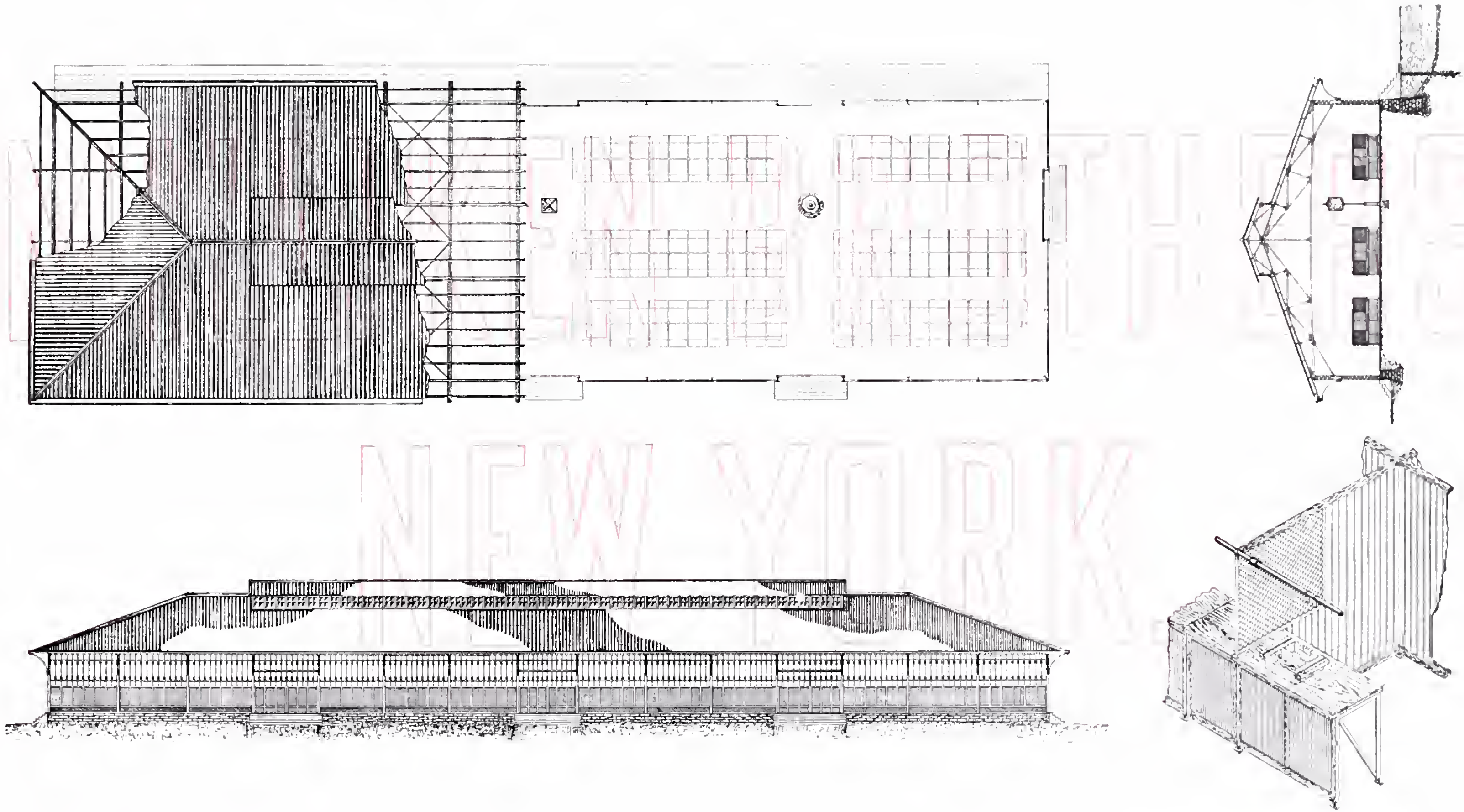
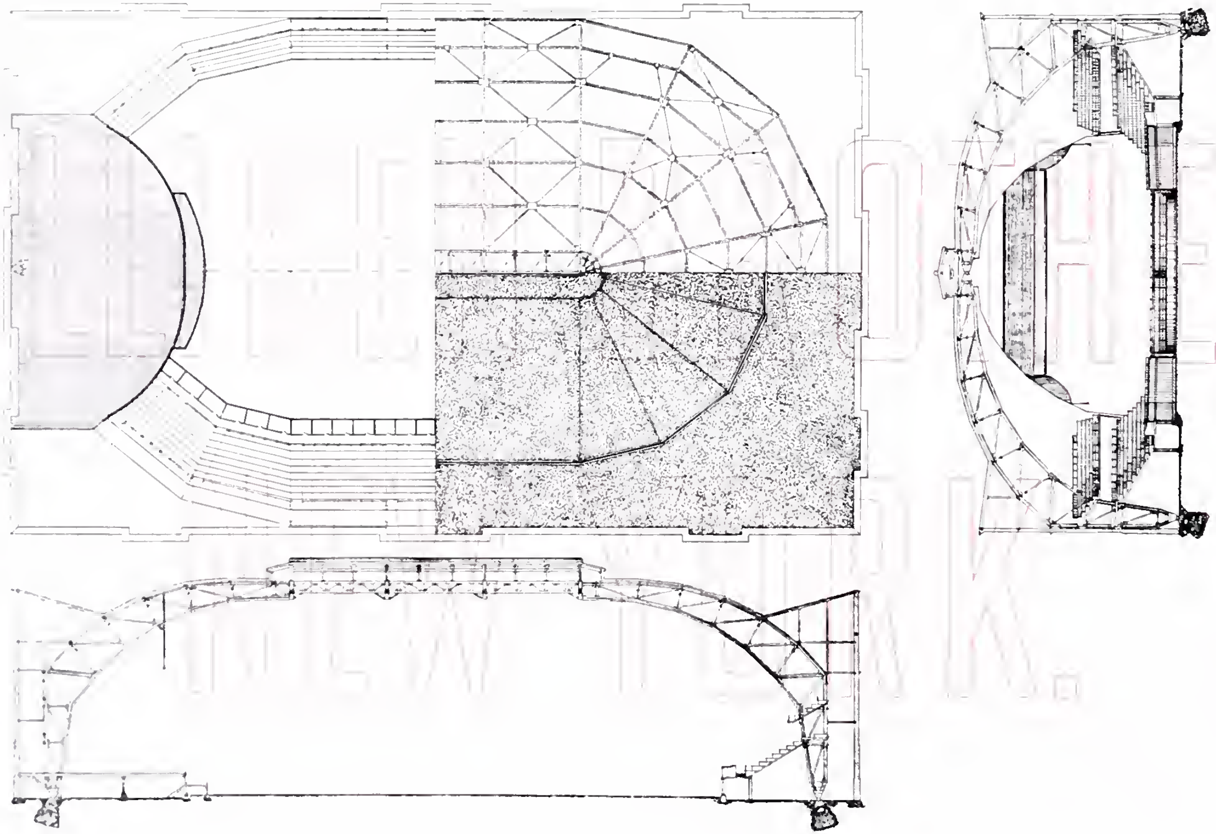
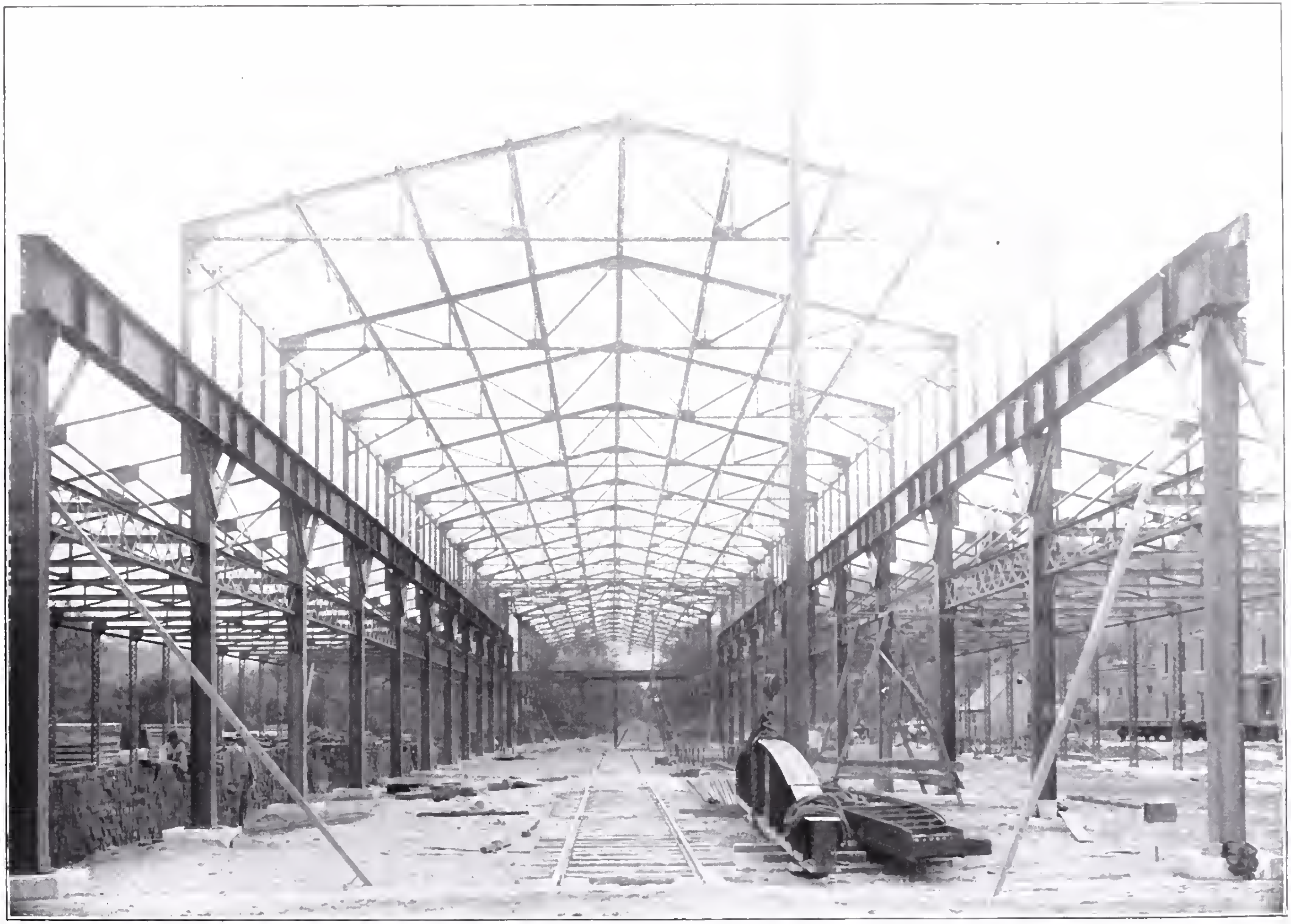


Plate No. 49.



Ingersoll Sergeant Drill Co. Machine Shop, Easton, Pa.



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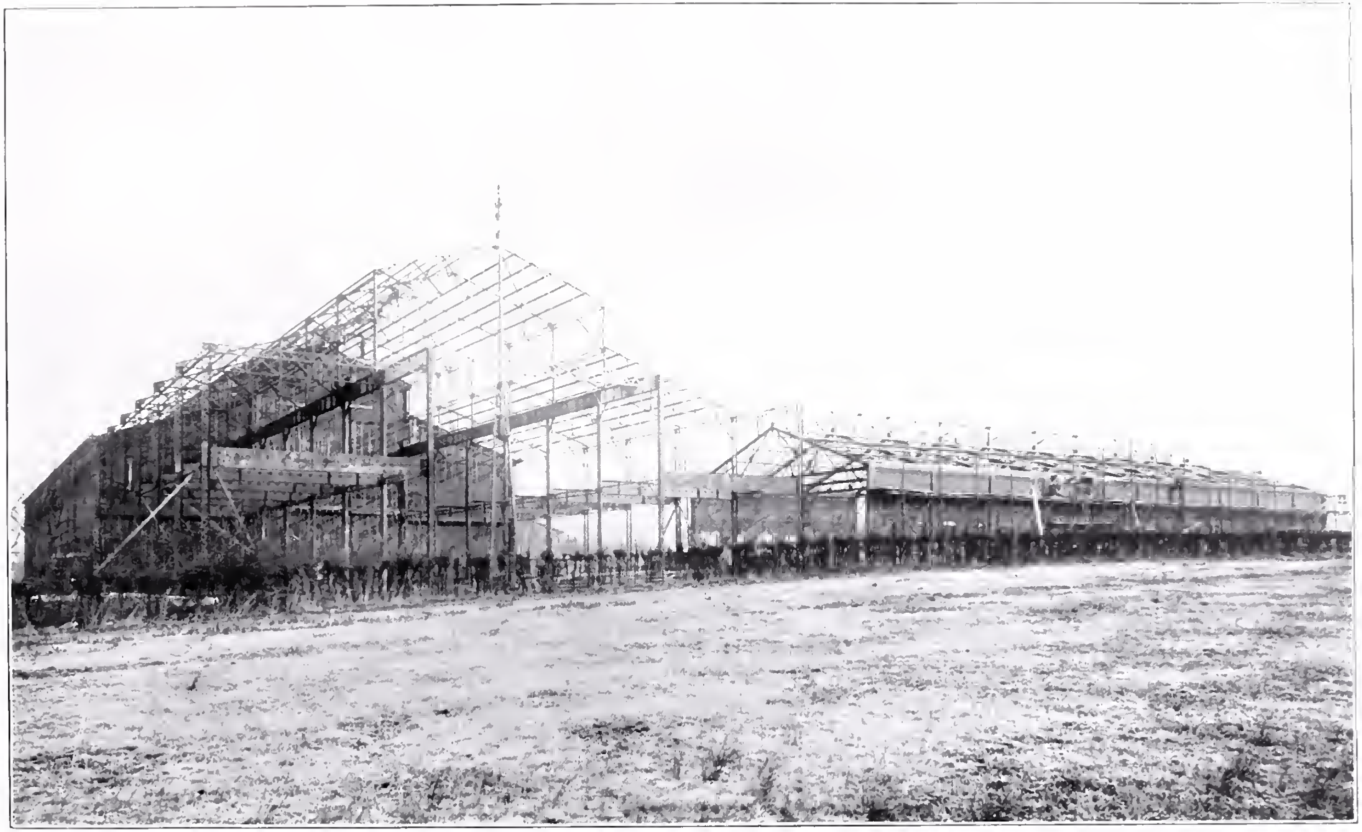
STEEL WORK DESIGNED, FURNISHED AND ERECTED BY MILLIKEN BROTHERS.

Sprague Electric Co.'s Machine Shop, Watsessing, N. J.



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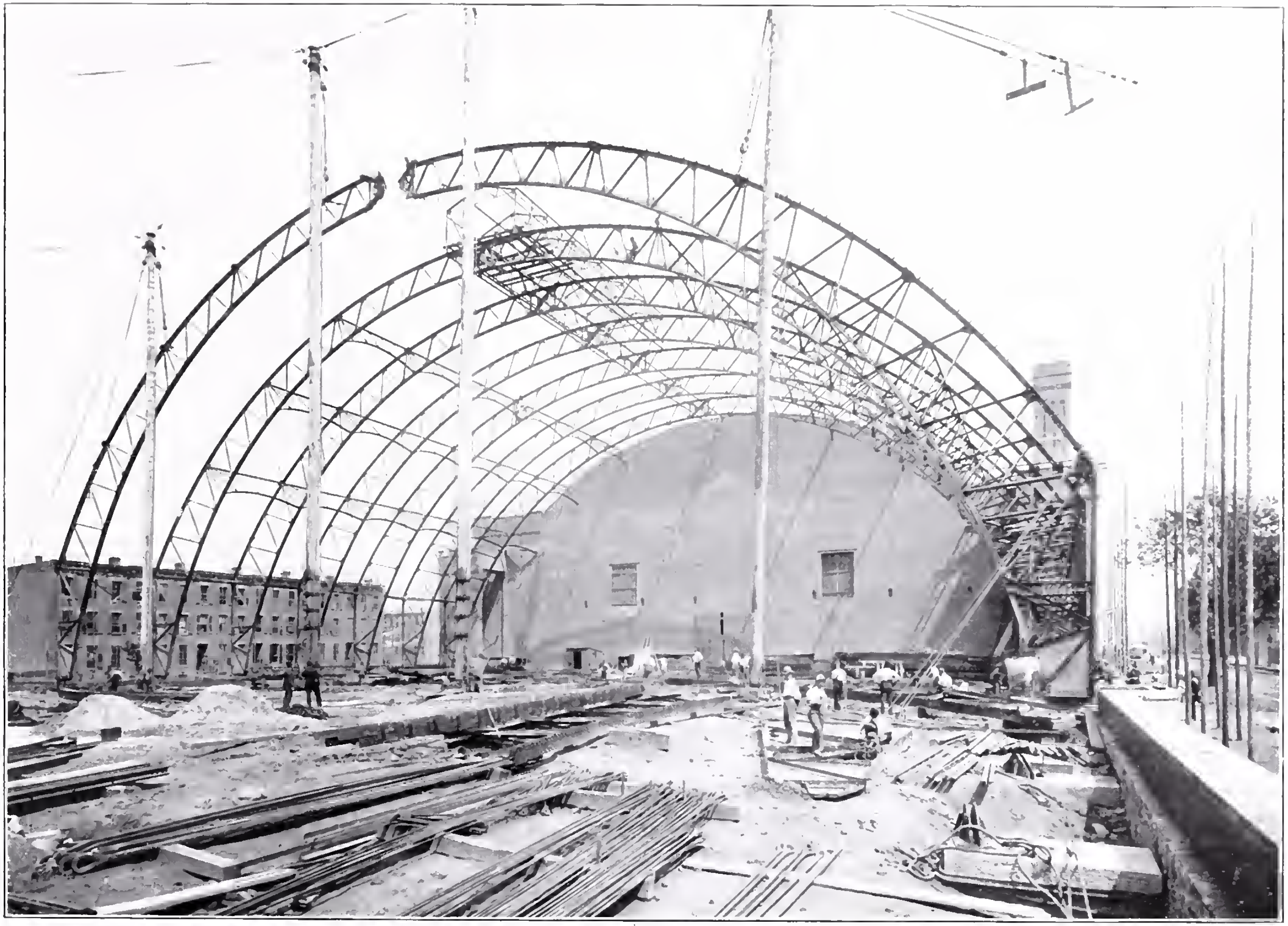

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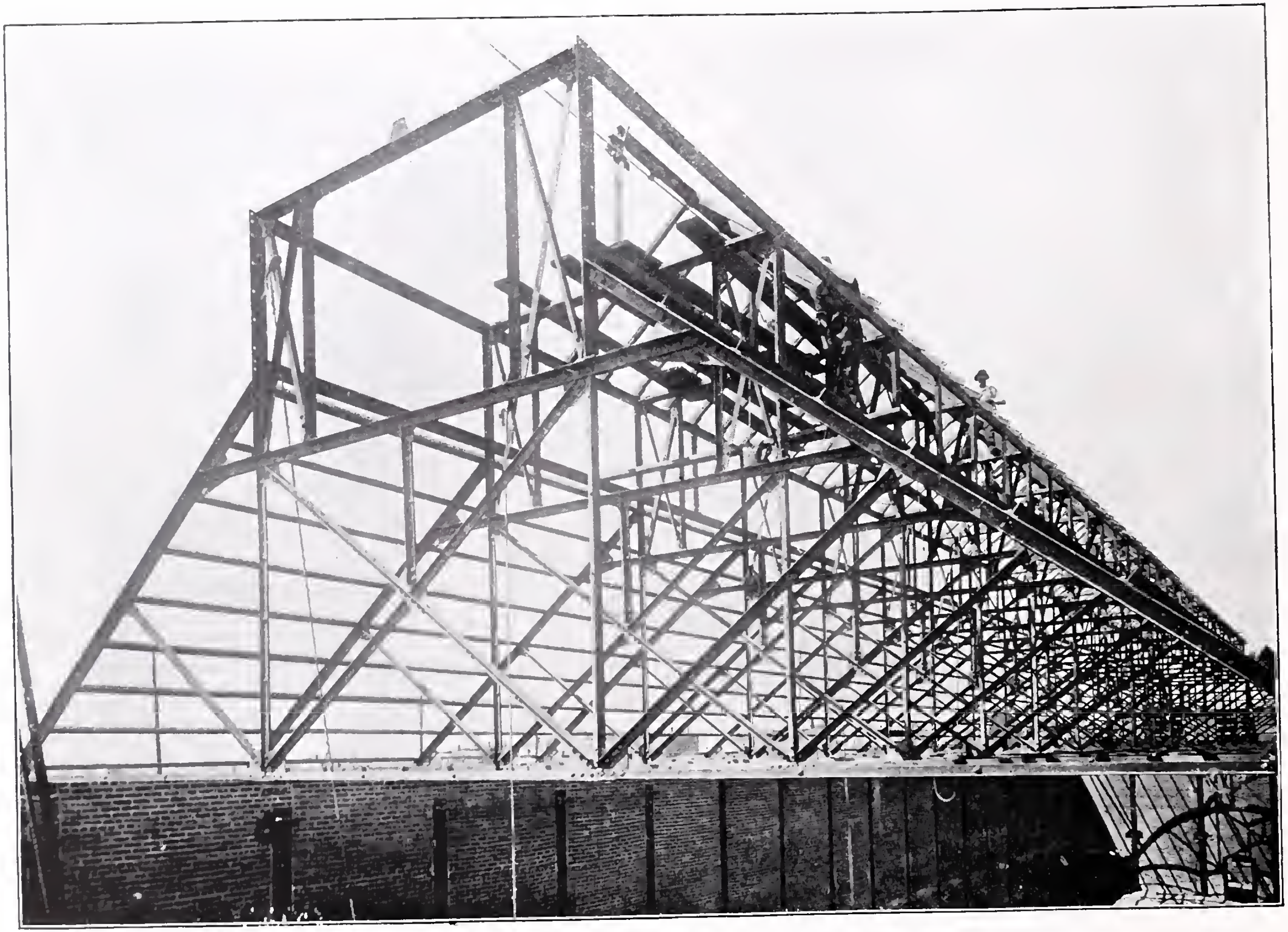
ATLAS PORTLAND CEMENT CO. PULVERIZER BUILDING, NORTHAMPTON, PA.

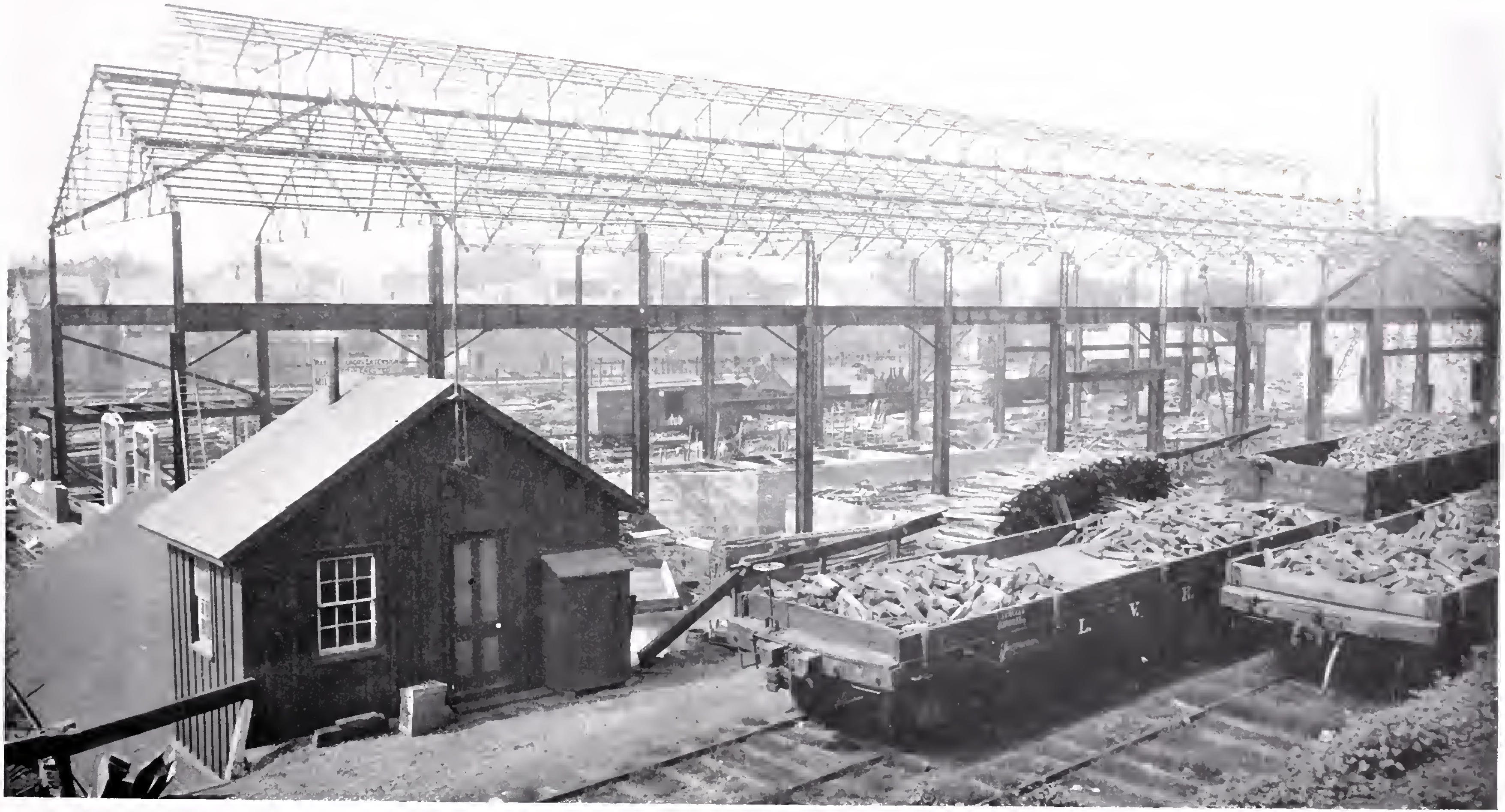
STEEL WORK DESIGNED, FURNISHED AND ERECTED BY MILLIKEN BROTHERS.

STEEL WORK DESIGNED, FURNISHED AND ERECTED BY MILLIKEN BROTHERS.



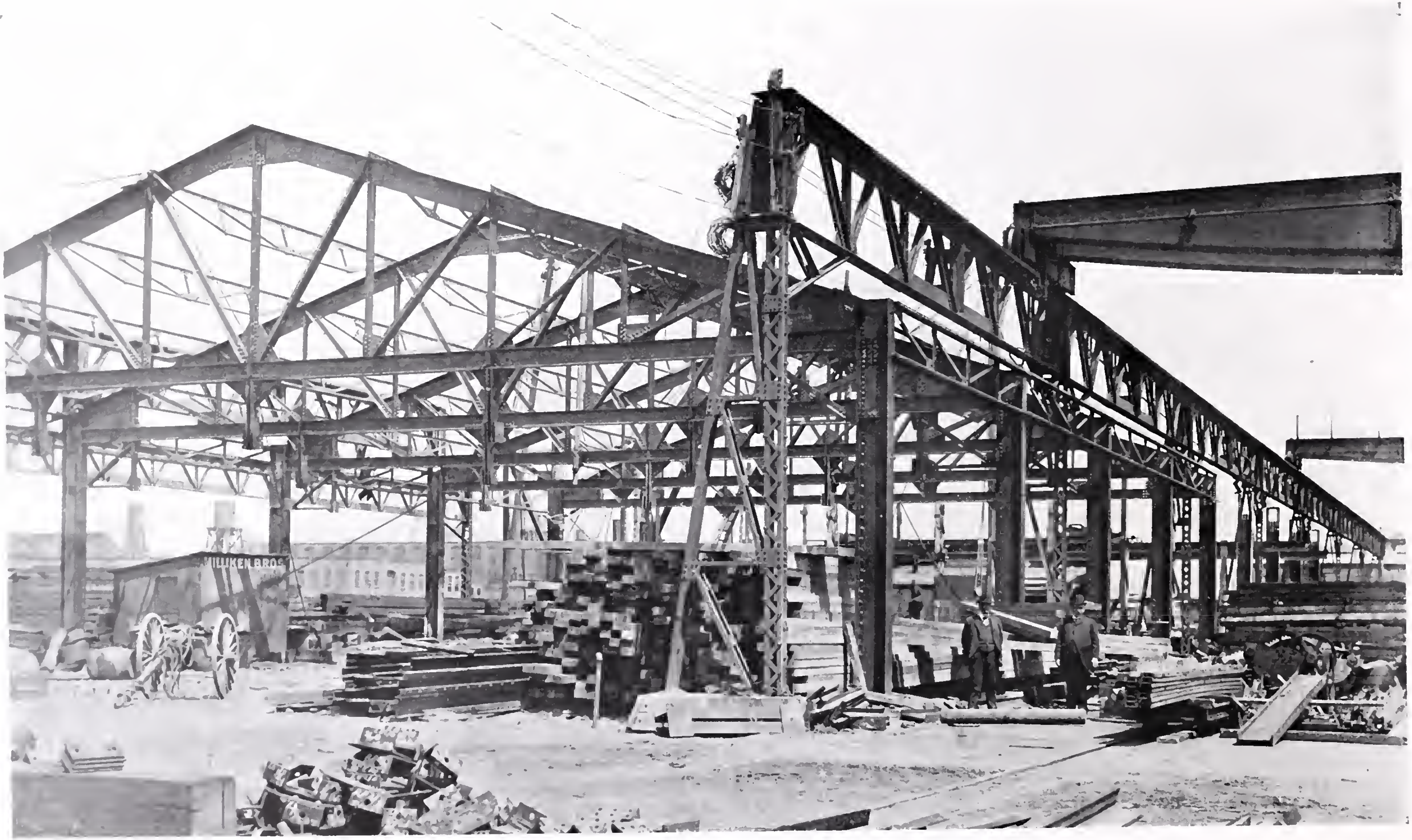
STEEL WORK DESIGNED, FURNISHED AND ERECTED BY MILLIKEN BROTHERS.

Warren Foundry Building, Phillipsburg, N. J.

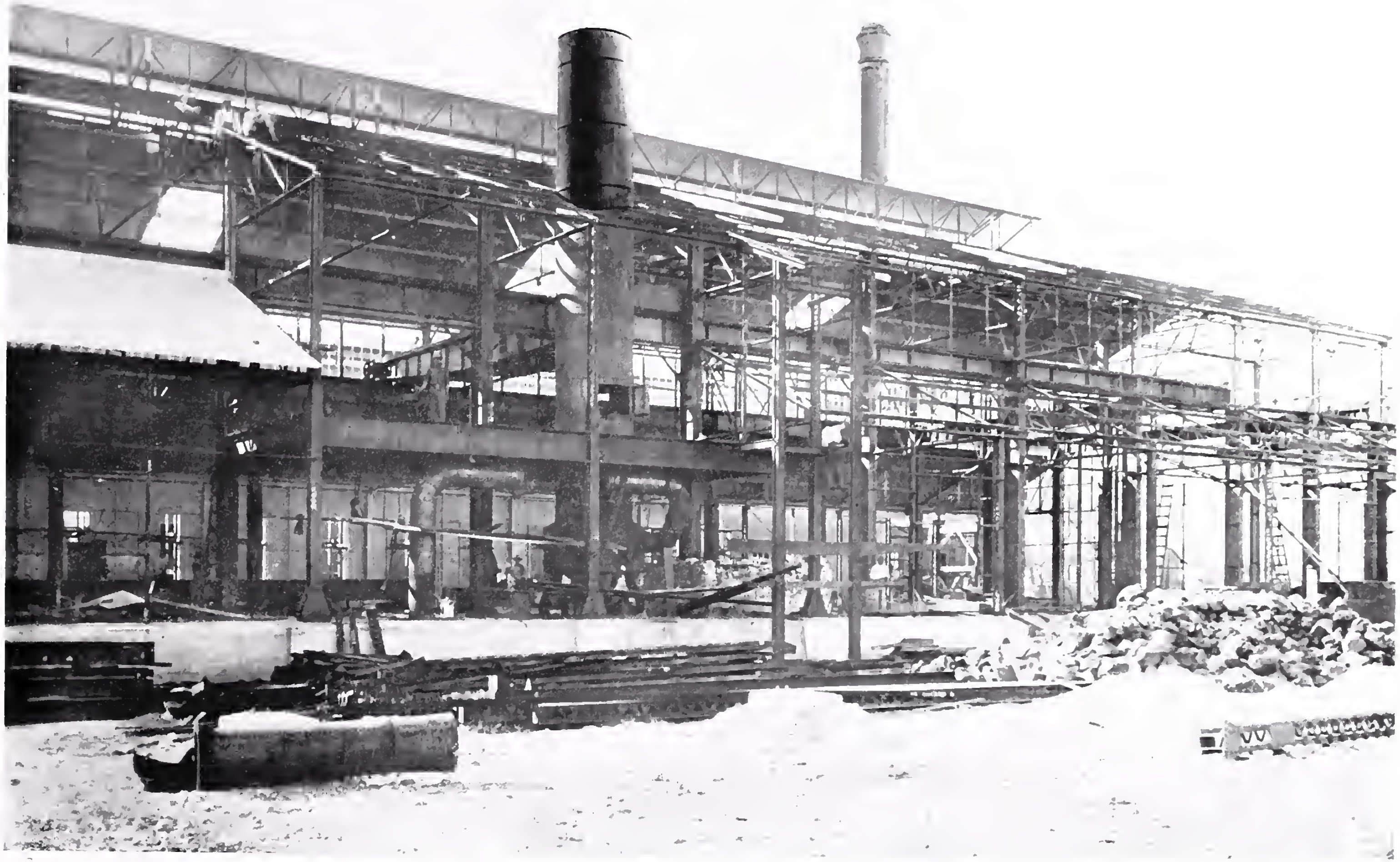


STEEL WORK DESIGNED, FURNISHED AND ERECTED BY MILLIKEN BROTHERS.

MILLIKEN BROTHERS' BRIDGE SHOP NO. 3.

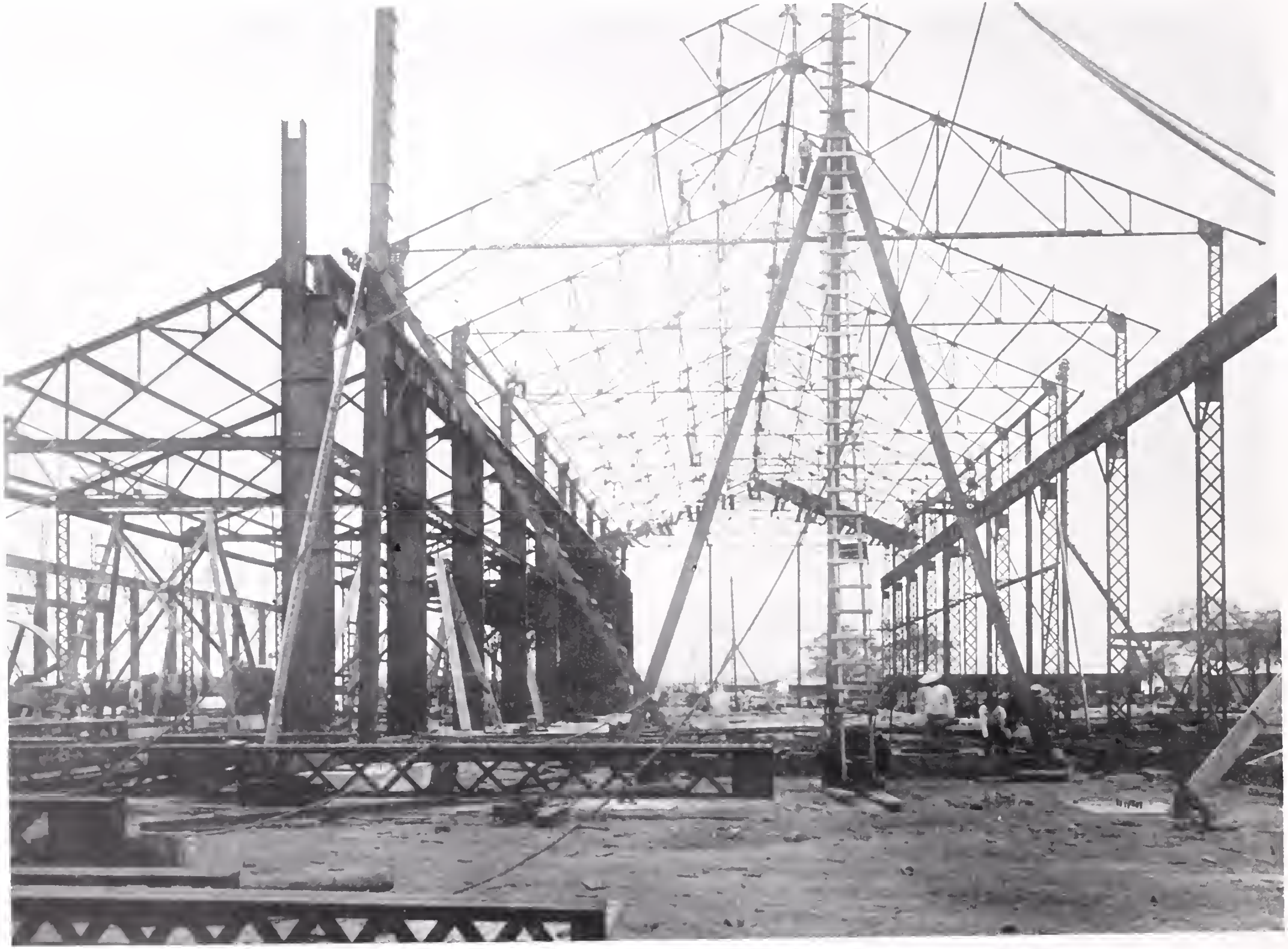


STEEL WORK DESIGNED, FURNISHED AND ERECTED BY MILLIKEN BROTHERS.



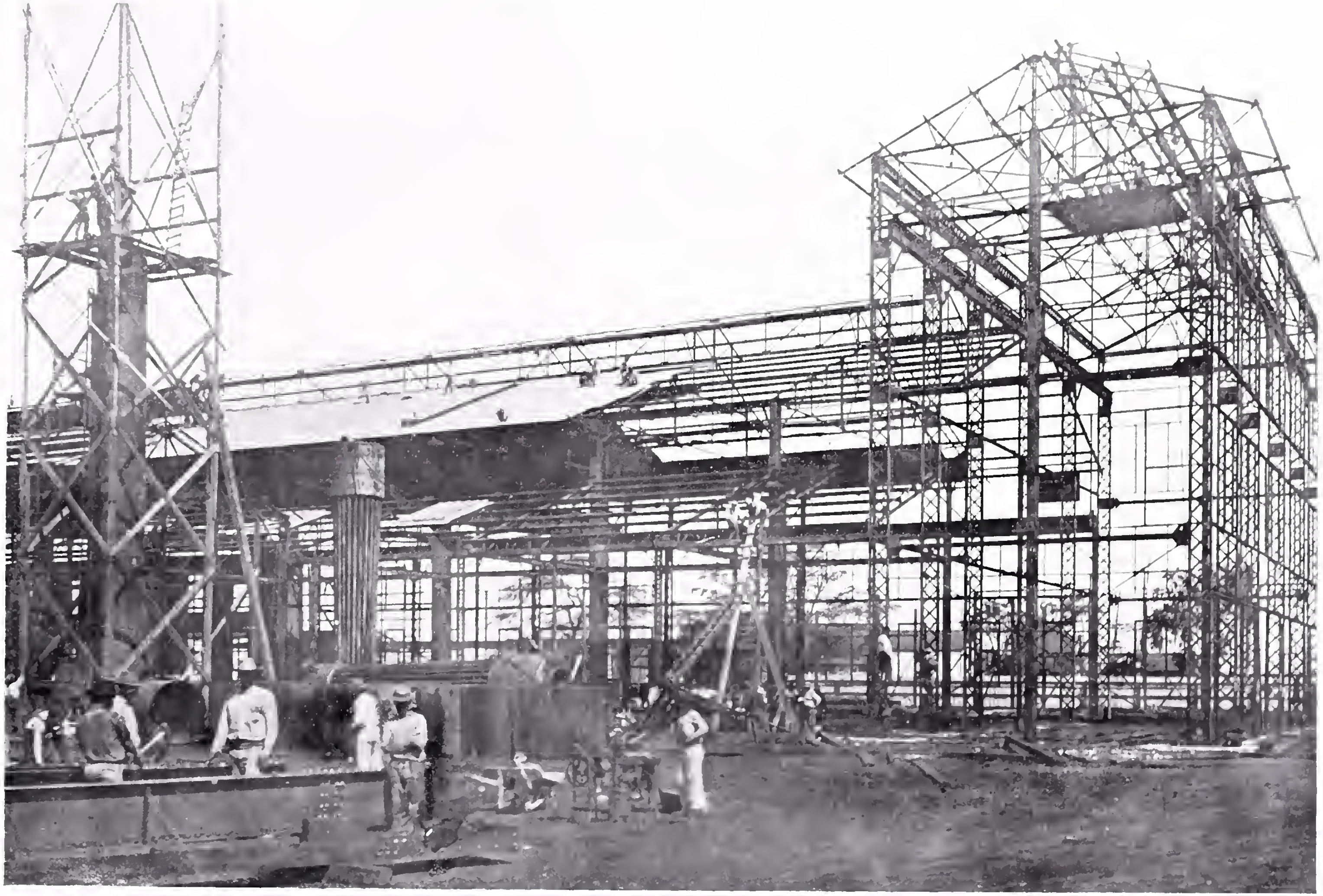
STEEL WORK DESIGNED, FURNISHED AND ERECTED BY MILLIKEN BROTHERS.

HONOLULU IRON WORKS MACHINE SHOP, HAWAIIAN ISLANDS.



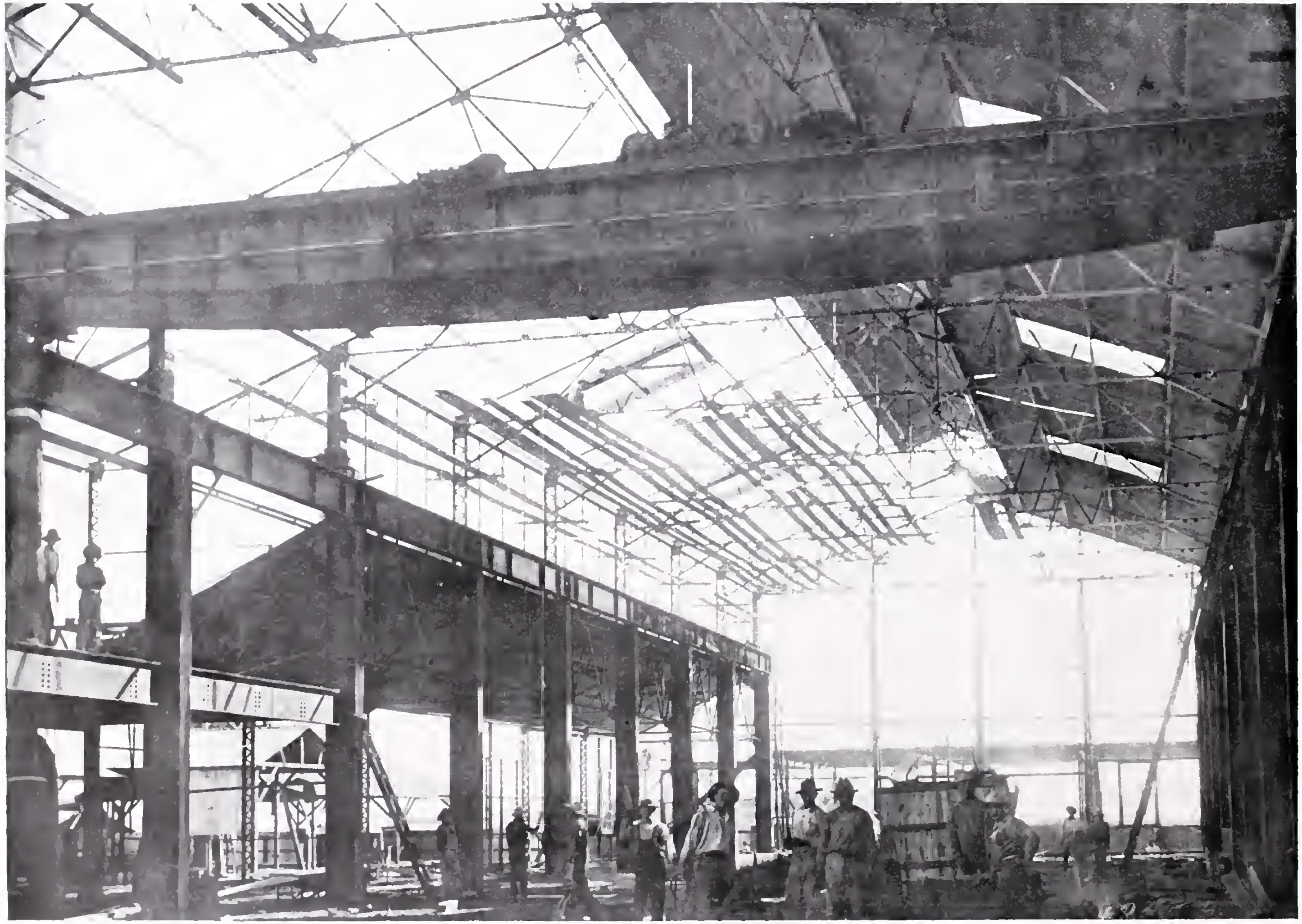
STEEL WORK DESIGNED, FURNISHED AND ERECTED BY MILLIKEN BROTHERS.

Honolulu Iron Works Machine Shop, Hawaiian Islands.



STEEL WORK DESIGNED, FURNISHED AND ERECTED BY MILLIKEN BROTHERS.

HONOLULU IRON WORKS FOUNDRY BUILDING, HAWAIIAN ISLANDS.



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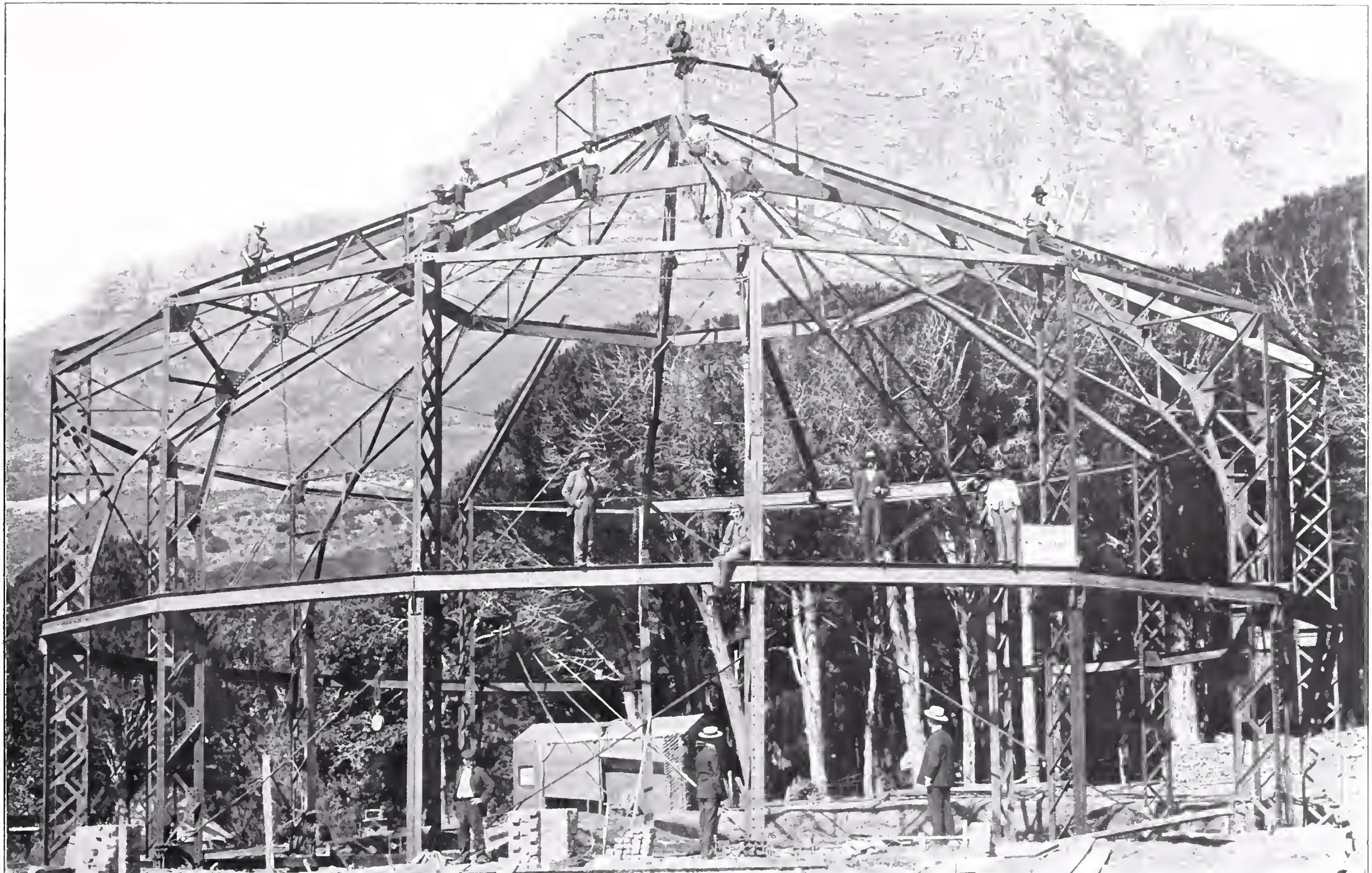
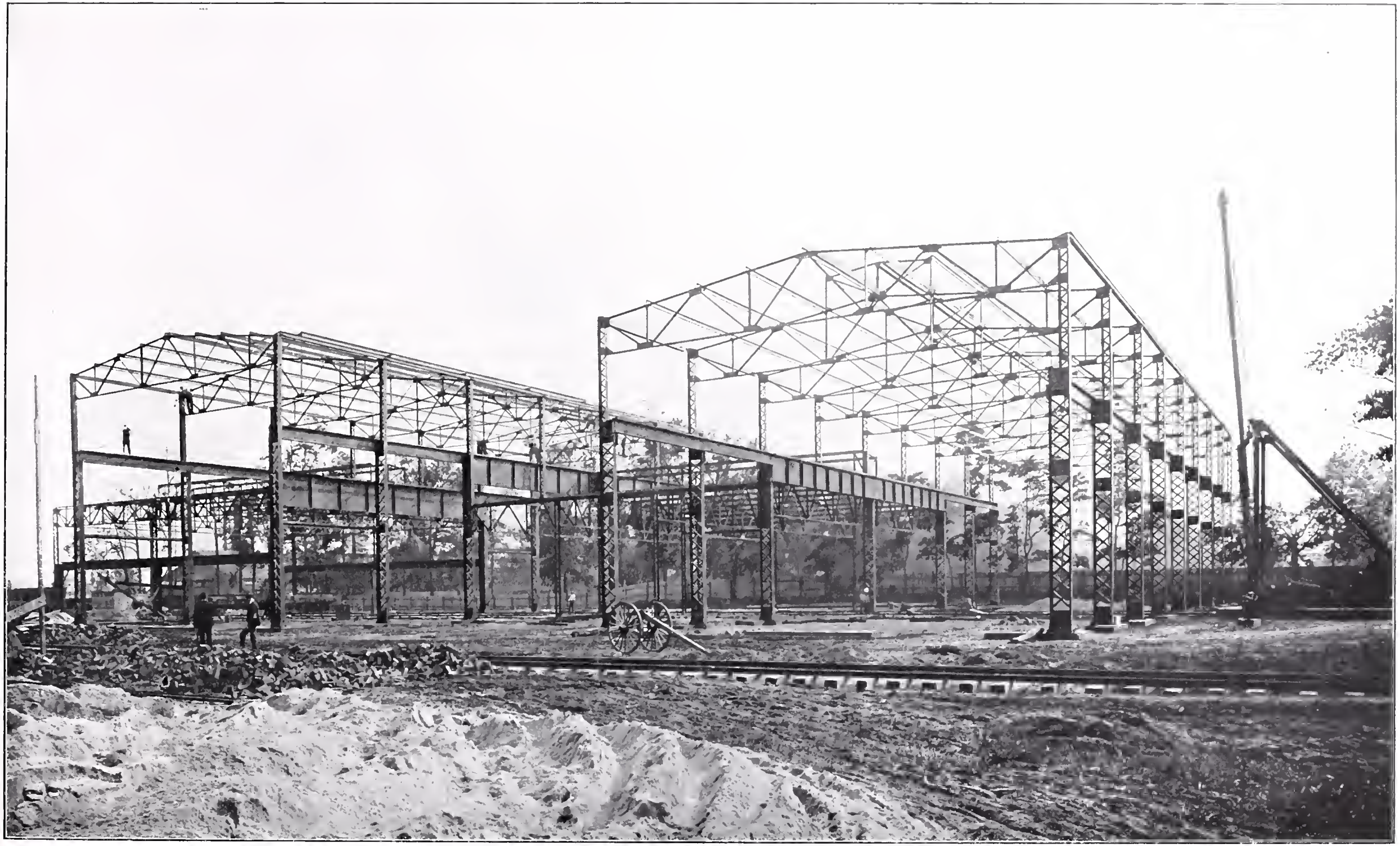


STEEL WORK DESIGNED, FURNISHED AND ERECTED BY MILLIKEN BROTHERS.

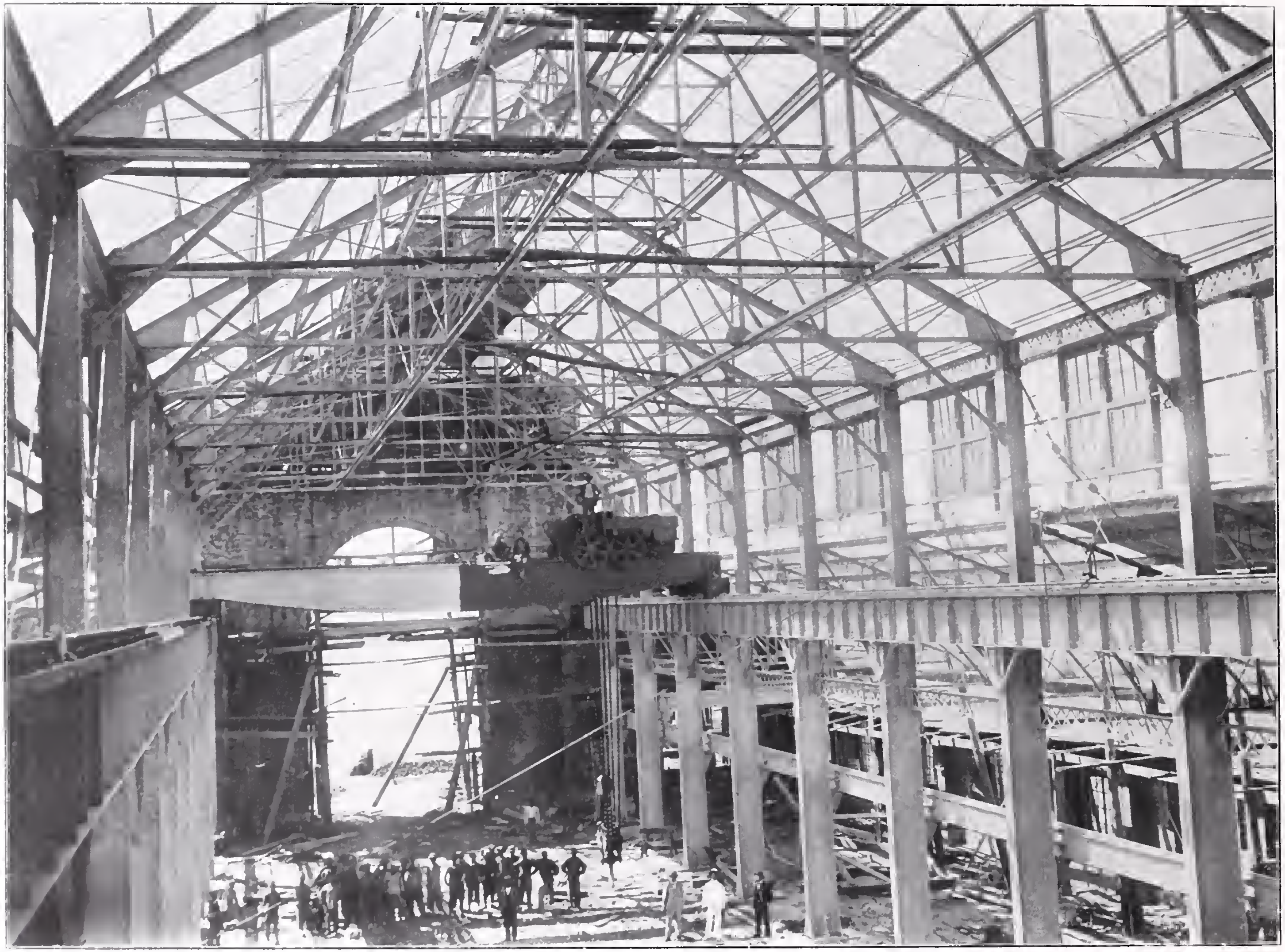
Central R. R. of N. J. Car Repair Shops, Elizabethport, N. J.

STEEL WORK DESIGNED, FURNISHED AND ERECTED BY MILLIKEN BROTHERS.



STEEL WORK DESIGNED, FURNISHED AND ERECTED BY MILLIKEN BROTHERS.

Russian Government Machine Shop, Port Arthur, Siberia.



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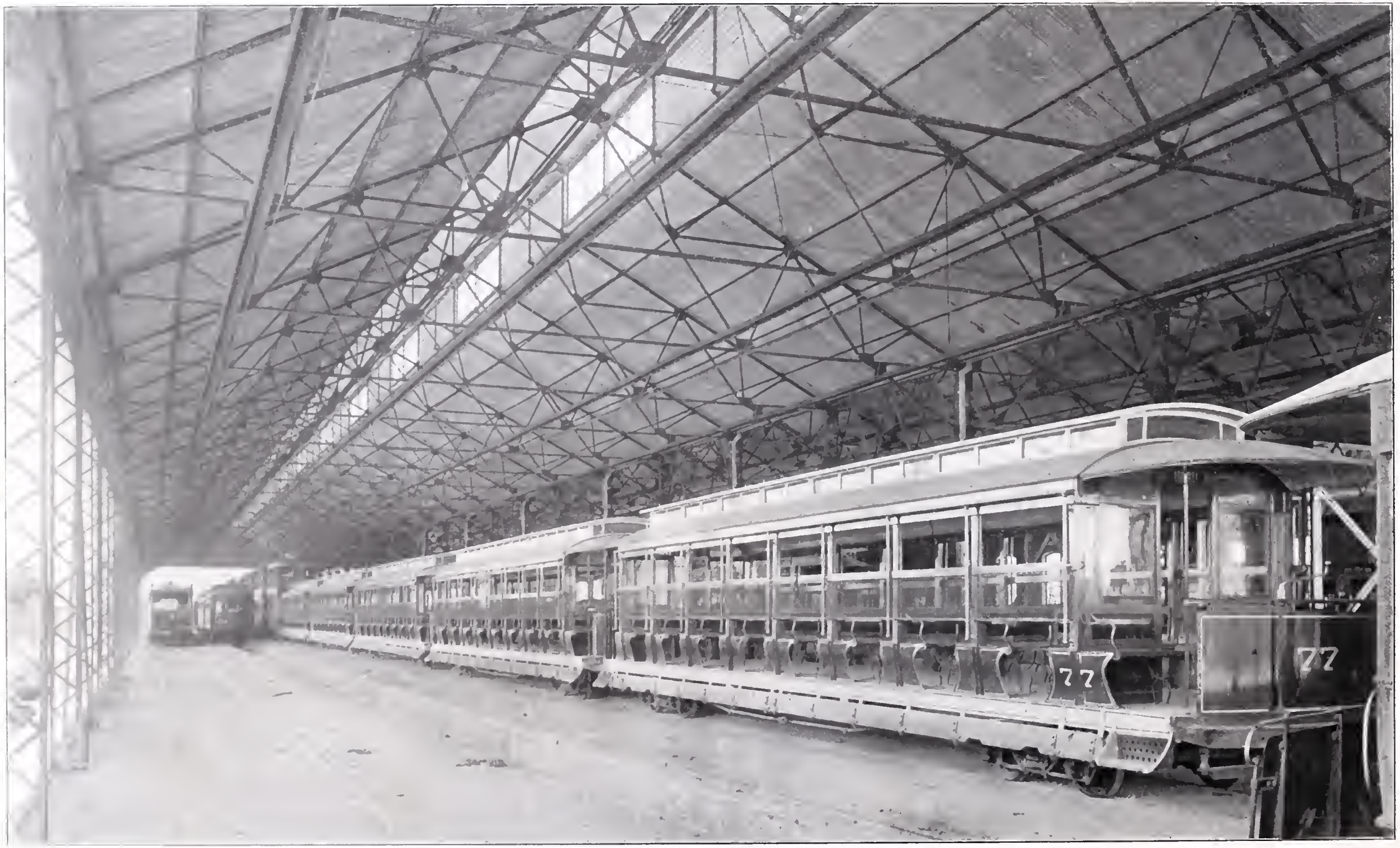
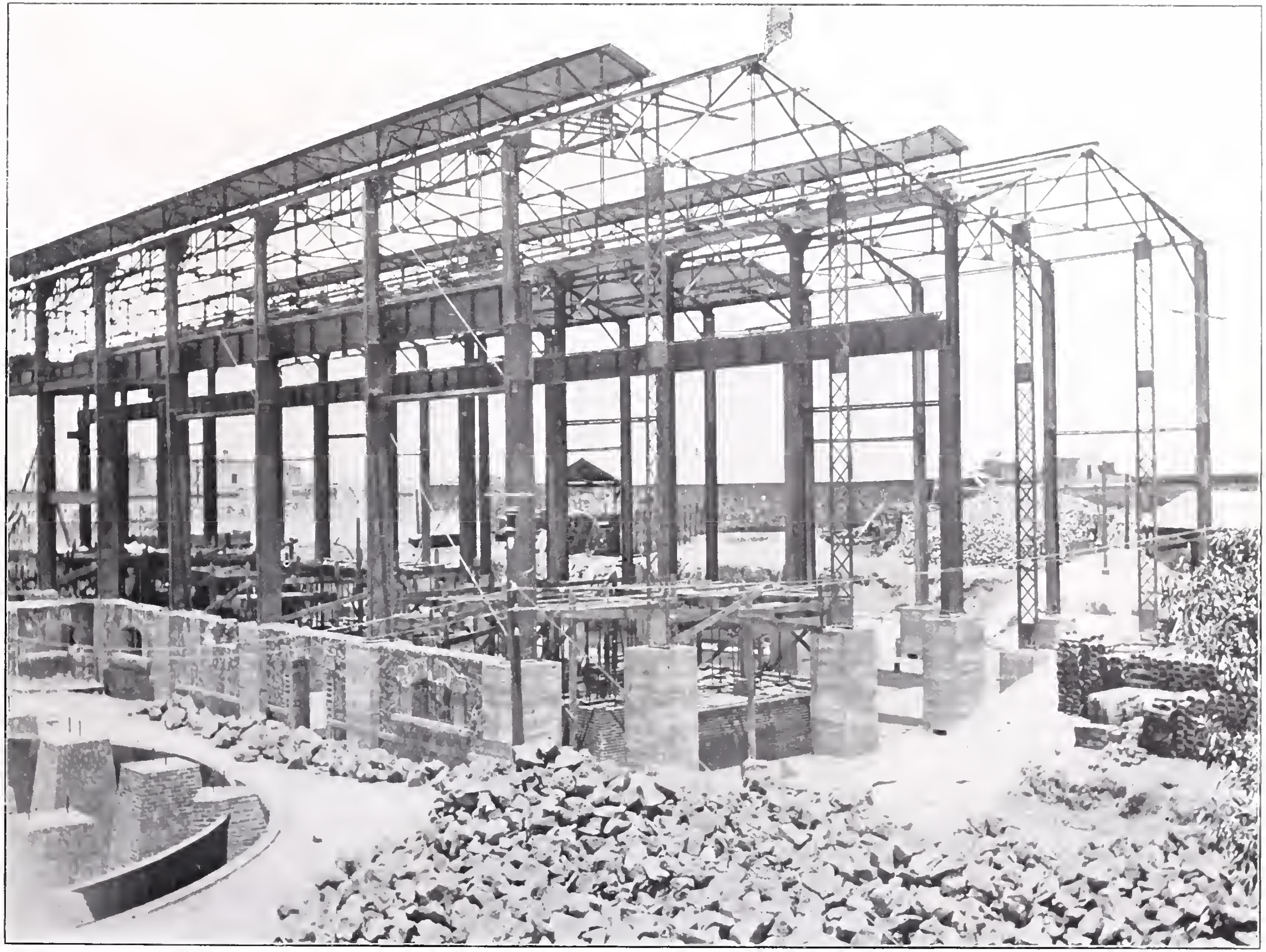


STEEL WORK FURNISHED BY MILLIKEN BROTHERS.



STEEL WORK DESIGNED AND FURNISHED BY MILLIKEN BROTHERS.

CANE AND BEET SUGAR MILL BUILDINGS.

Probably no class of buildings demands greater attention, owing to the valuable machinery which they contain, than sheds and buildings covering cane and beet sugar mills, and probably no class of buildings is so liable to suffer from fire on account of the combustible nature of the material stored in them and in their immediate vicinity. An owner can hardly estimate the loss and delay occasioned by fire, especially just before he is ready to grind, as such an accident means the loss of his entire crop, in addition to the loss of his buildings and machinery.

Some years ago it was customary to design cane sugar mills with low buildings extending over a considerable area of ground. The apparatus was installed either on ground level or on platforms a few feet above the ground. The latest design for cane sugar mill buildings calls for more or less of the apparatus to be elevated at a considerable height, and steel is almost universally used for the entire frame work of such buildings, for three reasons:

FIRST—The cost. Steel is now very cheap and with proper engineering skill a building can be designed with a minimum amount of material. Wood is expensive; it does not last long and requires all of the skilled labor to be sent to the building site to frame it and put it in place.

SECOND—A sugar mill of all places should be light and airy, and above all, clean. None of these points can be accomplished by the use of a wooden structure.

THIRD—Steel buildings are fire-proof, while wooden buildings are not.

We will now briefly describe the main buildings that go to make a complete cane sugar mill plant:

We first have the cane shed. This is a steel constructed building covered on the top with sheet metal, open on the sides and of sufficient length and width to contain the cars of cane and the cane conveyer. The roof trusses can be made strong enough to support a cane unloader, if the same is desired.

The next building is the grinding house, containing the crusher, grinding mills and engine. This building is constructed of steel and covered with sheet metal. Its sides and ends are entirely closed in; they are supplied with plenty of windows and louvres for ventilation. Inside of this building there should be a hand-traveling crane, to be used for changing the rolls of the grinding mill, or to make any necessary repairs to the engines. These cranes will be found to pay for themselves simply on installing the mills and engines, not to speak of their usefulness in case of an accident to the grinding rolls. These cranes are fully described later on in this catalogue.

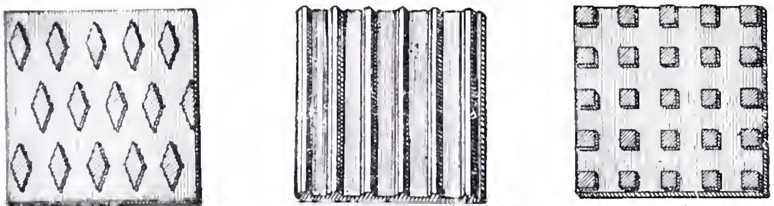
The next building is the boiler house. This structure covers the boilers, economizers and bagasse floor. In a number of plants which we have built the bagasse floor is above the ground. The space underneath the floor is used for getting draught to the boilers. This building is also enclosed in sheet metal work, special attention being given to ventilation. A steel stack is usually required for the boilers. These stacks are fully described later on in this catalogue.

We cannot recommend too highly the use of a properly proportioned, self-supporting, steel smoke stack. Its first cost is very much less than a brick stack, and it can be erected in one-quarter of the time.

The next building to be considered is the boiling house. This is by far the largest and most important one of the group. It is constructed entirely of steel frame work, the outside of sheet metal, with plenty of windows for light and ample ventilation. It is usually about three stories in height. On the upper floor rest the strike pans and tanks; below this floor rest the crystallizers, and again below this, the centrifugals. The bag filter, juice weighing machine, defecators, liming tanks, and other parts of the machinery rest on floors of

different levels. These heights and levels are to a great extent determined by the exact class of machinery installed, and a wing to the building forms the sugar room and sometimes a separate room for the storage of sugar ready for shipment.

In the latest and best designed sugar plants the floors on which the machines rest are constructed of steel beams. These floors form a portion of the building itself, and so brace the entire structure, which is clearly shown in a number of photographs given in this book. In many cases owing to the enormous size and weight of the machines it would be impossible to support them safely on wooden construction. The floors between the steel beams are usually constructed of temporary wooden planks laid on top of steel beams until all the piping is definitely located; we then suggest that the wood be removed and the permanent floor constructed of concrete, (such as is described in the first part of this catalogue) and the top surface of this concrete finished with asphalt, to make the same water-proof. The floors can then be properly washed and kept absolutely sweet and clean. We have constructed floors in sugar mill buildings in which steel floor plates were furnished by us, which rested directly on top of the steel floor beams. This makes a non-combustible floor and one which is light and can easily be kept clean. Figure No. 7 shows the patterns in which these floor plates are rolled.



Diamond Pattern. *Rib Pattern.* *Checkered Pattern.*

FIGURE 7

Access from floor to floor in the boiling house is had by means of stairs, and in some cases we have furnished elevators. In order to avoid any danger of fire we recommend that the wooden window frames be entirely encased in sheet metal, and that all large openings be protected by rolling steel shutters instead of wooden doors.

We are prepared to estimate and furnish all kinds of staging and framing required for the support of the numerous machines used in sugar mill buildings, like Defecators, Clarifiers, Condensers, Tanks, Vacuum pans, Crystallizers, Centrifugals, etc., etc., but in new plants, as we have stated above, these usually rest on floors which are specially designed to take the loads.

In and around every sugar plantation there are numerous other buildings and structures which require steel, such as cooling towers, steel troughs, aqueducts, tanks, bridges, power plants, pumping plants, electric light plants, round houses for the storage of locomotives, machine shops, turn tables, etc., etc. All of this work we make a specialty of designing and constructing.

We will now give a short description of some few of the important plants which we have lately built, nearly all of which are illustrated by photographs and drawings.

The picture on page 189 shows the completed Oahu Sugar Mill that we recently built in the Hawaiian Islands. This mill has a capacity of 1200 tons of cane, equivalent to 150 to 175 tons of sugar every 24 hours.

The picture on page 190 shows the structural steel frame work of the grinding house and boiler house before the same is covered with the sheet metal work.

The photograph on page 191 shows the structural steel work for the boiling house in process of erection. The end of the boiler house is shown at the extreme right, and in this case, this building is covered with the sheet metal work.

The photograph on page 192 is of the completed mill looking at the building from the cane receiving shed end.

The picture on page 193 is a view of the completed plant looking at it from the sugar room and shipping shed end of the boiling house.

The photograph on page 194 is taken inside the cane receiving shed which shows the arrangement of the conveyer etc. for receiving the cane.

The photograph on page 195 is taken in the interior of the grinding house and shows clearly the arrangement of the hand traveling crane over the crusher, sugar mills and engine.

The photograph on page 196 is an interior view of the boiling house and shows at the extreme top the strike pan floor, underneath it the crystallizers and again underneath these the centrifugal and the lower floor of course, is used for sugar shipping.

The cut on page 197 shows the completed plant of the Waialua Sugar Mill which we erected in the Hawaiian Islands. The capacity of the mill is 1200 tons of cane, equivalent to 150 to 175 tons of sugar every 24 hours.

The photogragh on page 198 shows the mill nearing completion and is taken from the cane shed end of the building.

The photograph on page 199 is taken at the end of the boiling house and shows the arrangement of the strike pans, crystallizers, etc.

The photograph on page 200 is taken near the boiler house and shows the starting and method of erecting the smoke stack.

The cut on page 201 shows the completed plant of the United Fruit Co. at Banes, Cuba. The capacity of this mill is 150 tons of sugar every 24 hours.

The photograph on page 202 was taken during the erection of this work.

The cut on page 203 shows the completed plant of the Olaa Sugar Mill which we erected in the Hawaiian Islands. The capacity of this mill is 1200 tons of cane equivalent to 150 to 175 tons of sugar every 24 hours.

The photograph on page 204 is of this mill during erection looking toward the boiling house and grinding house and shows very clearly the arrangement of the floors in the boiling house.

The photograph on page 205 is the same as the above, only taken in another direction.

The photograph on page 206 shows the buildings when practically completed. The view is taken looking at the end of the cane receiving shed.

The photograph on page 207 is an interior view of the crushing and grinding rolls, showing the end of the overhead hand traveling crane.

The cut on page 208 shows the completed sugar mills building for the Maui Sugar Mill that we built in the Hawaiian Islands. This factory is without question the largest one of its kind in the world. The mills, of which there are three sets, have a capacity of 3600 tons of cane, equivalent to 550 tons of sugar every 24 hours.

The photograph on page 209 shows this extensive mill when nearing completion, the photograph being taken on the rear end of the boiling house and bag and filter house.

The photograph on page 210 is an interior view showing the crushing and grinding rolls and overhead traveling crane.

The photograph on page 211 shows in the upper part the strike pans. Below this, the crystallizers, below this the centrifugals, sugar storage room and shipping shed.

The photograph on page 212 is taken on the strike pan floor.

The cut on page 214 represents the completed plant of the Kauai Sugar Mill Building which we built in the Hawaiian Islands. This has a capacity of 1000 tons of cane, equivalent to 120 to 125 tons of sugar every 24 hours.

The photograph on page 215 shown on the left hand, the new portion of the sugar mill buildings. On the right hand end are the old and original buildings of this plant.

The cut on page 216 shows the completed plant of the Francisco Sugar Co. at Guayabal, Cuba. This plant has a capacity of 1200 tons of cane, equivalent to 150 to 175 tons of sugar every 24 hours.

The cut on page 217 shows the completed plant of the Molokai Sugar Mills in the Hawaiian Islands. This plant has a capacity of 1500 tons of sugar cane, equivalent to 150 tons of sugar every 24 hours.

The cut on page 218 illustrates the completed plant of the Ewa Sugar Mill which we erected in the Hawaiian Islands. There are two mills connected with this plant and their combined capacity is equivalent to 2400 tons of cane or 300 to 350 tons of sugar every 24 hours,

These buildings were erected over existing buildings and during the grinding season, which shows that old plants can be remodeled and made up to the latest standard without interfering with the grinding of their crops.

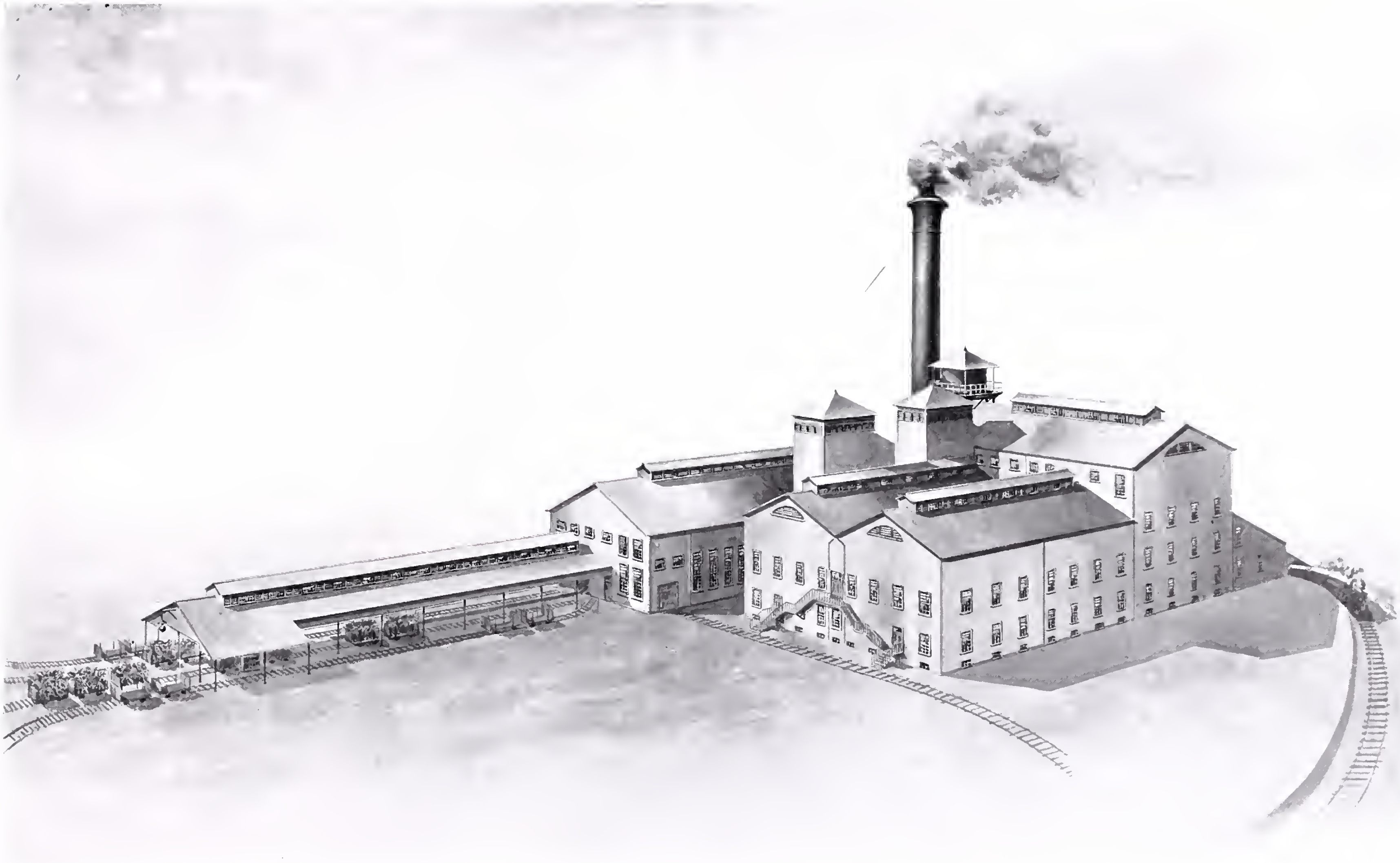
The photograph on page 219 shows the Sugar Mill Building which we built in Yngo. Elizalde in Cuba.

The photograph on page 220 shows a roof over a storage house for the American Beet Sugar Co., California.

The photograph on page 221 shows the completed building of a store house which we designed and built in New York City.

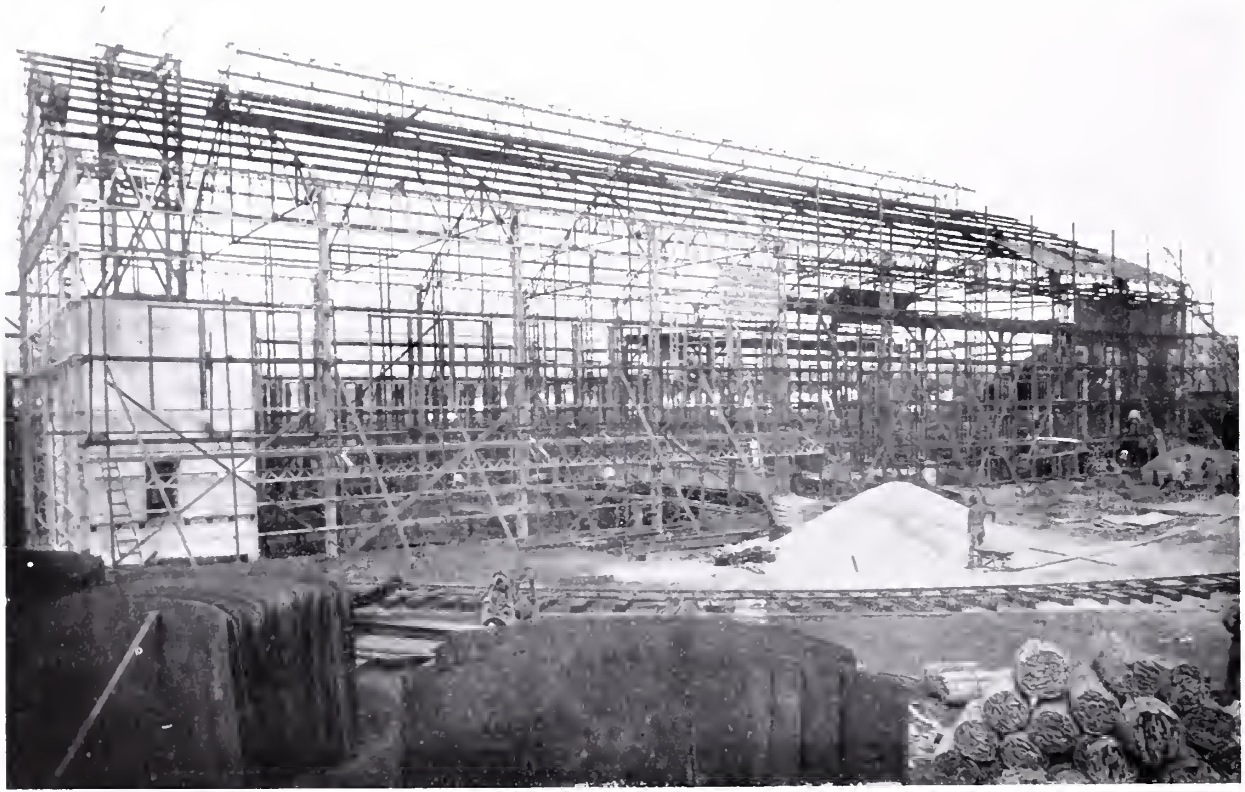
The photograph on page 222 shows the steel frame work for this building before it was covered with the sheet metal. This form of a store house is particularly adaptable to plantation work for the storage of sugar or any other material that requires to be housed in a fire-proof building.

The photograph on page 223 shows the completed sugar mill plant for the Cape Cruz Sugar Company in Cuba.



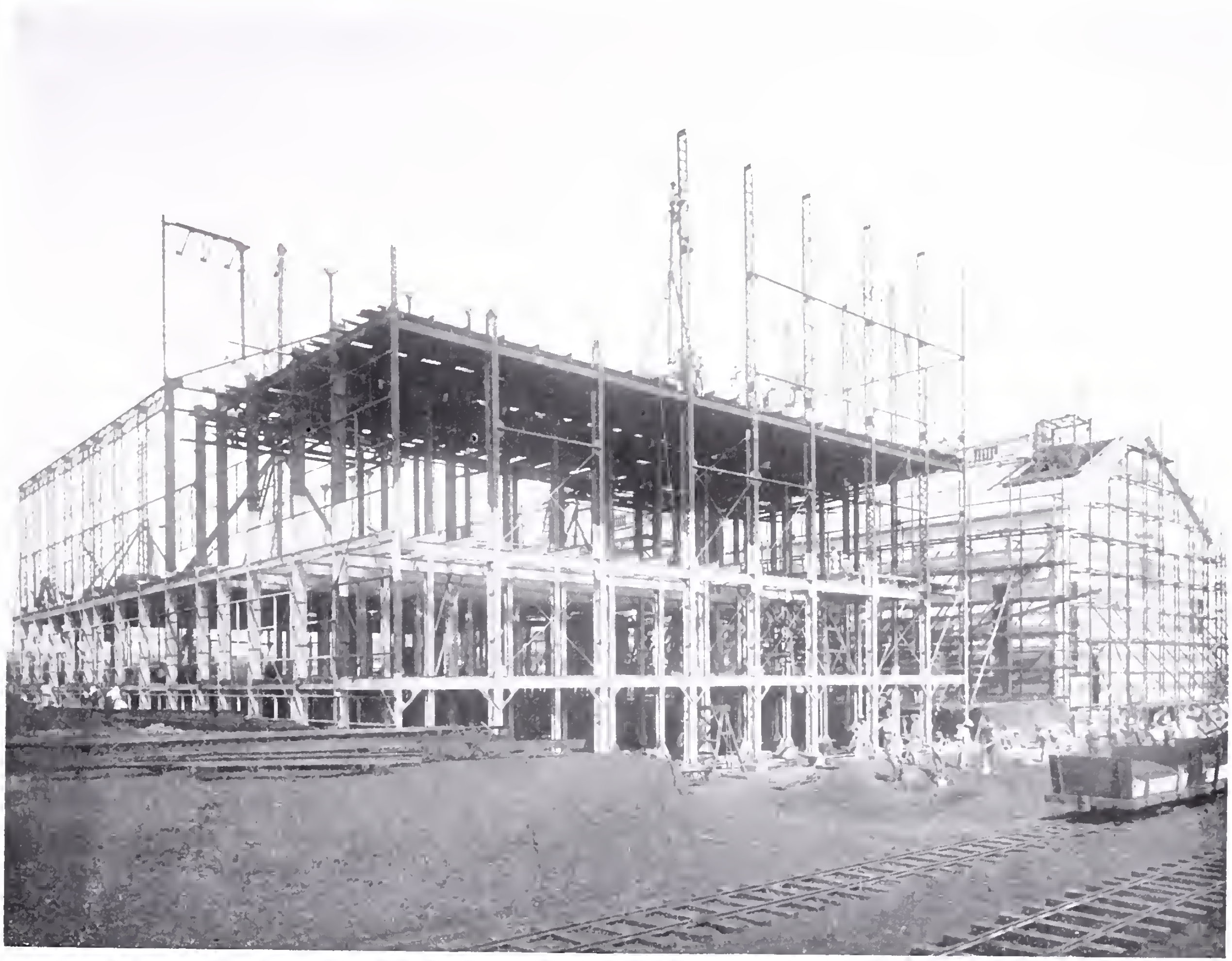
STEEL WORK DESIGNED, FURNISHED AND ERECTED BY MILLIKEN BROTHERS.

Oahu Sugar Co. Boiler House and Grinding Mill, Honolulu, H. I.



STEEL WORK DESIGNED, FURNISHED AND ERECTED BY MILLIKEN BROTHERS.

OAHU SUGAR CO. BOILING HOUSE, HONOLULU, H. I.



STEEL WORK DESIGNED, FURNISHED AND ERECTED BY MILLIKEN BROTHERS.

Oahu Sugar Co. Complete Buildings, Honolulu, H. I.

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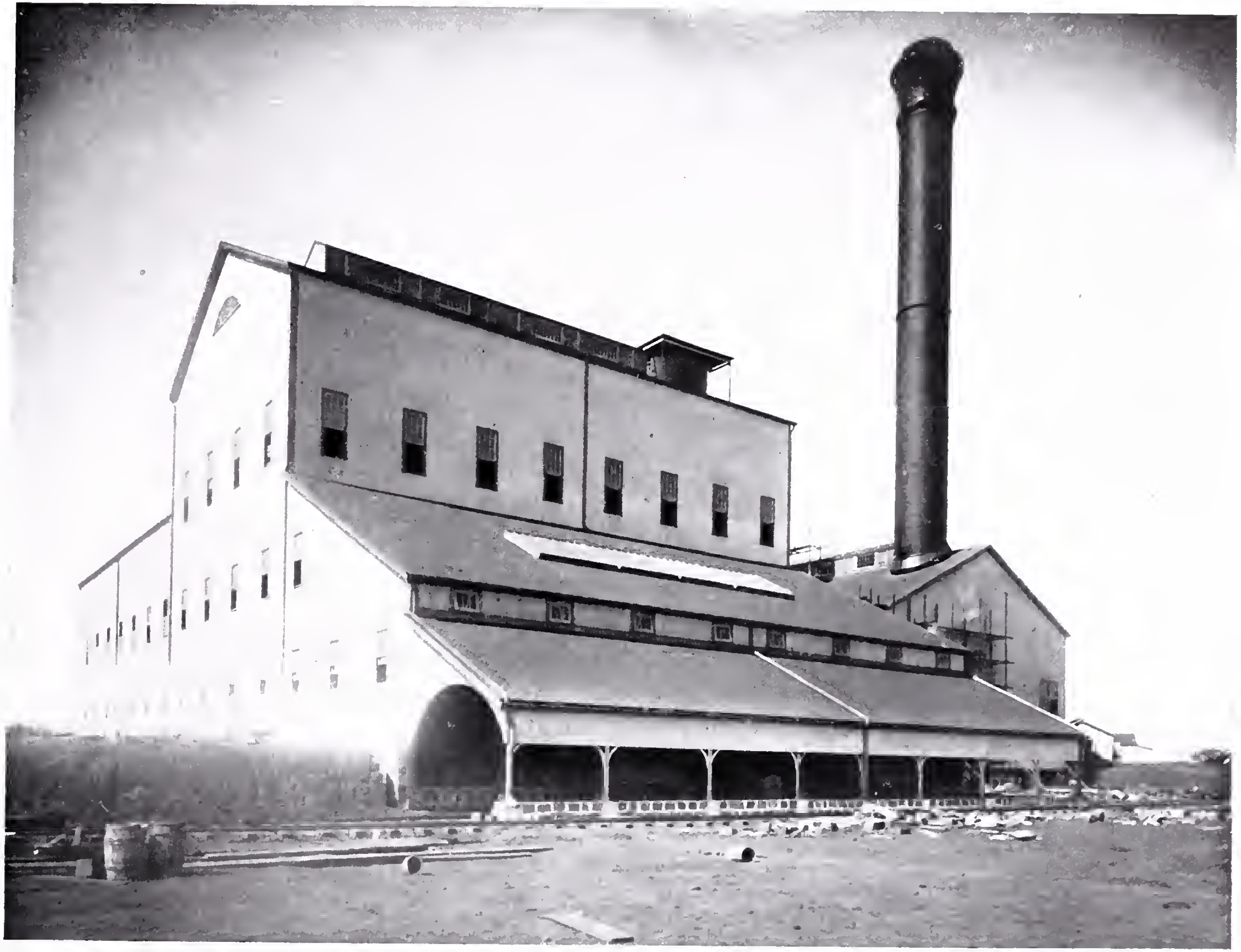
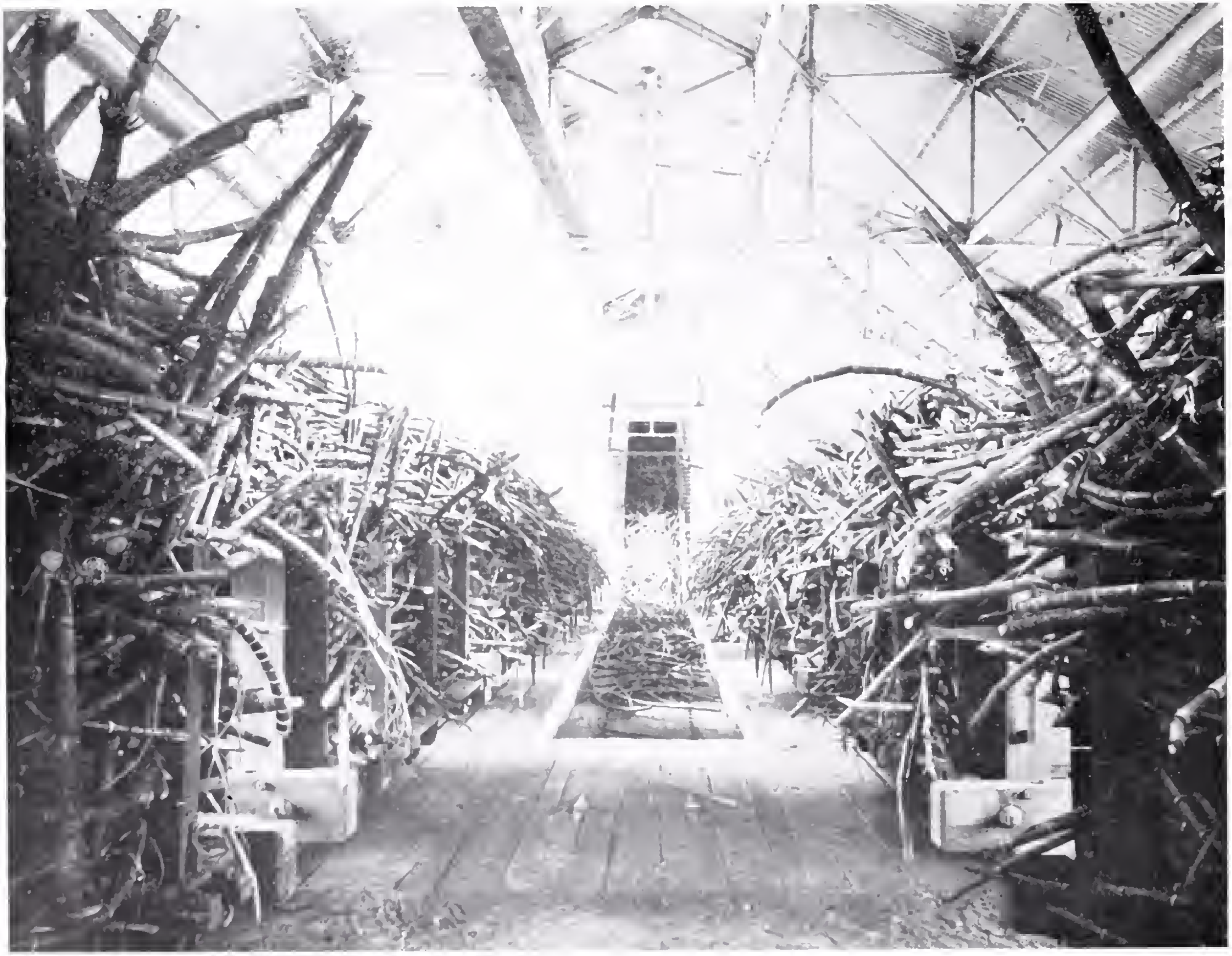
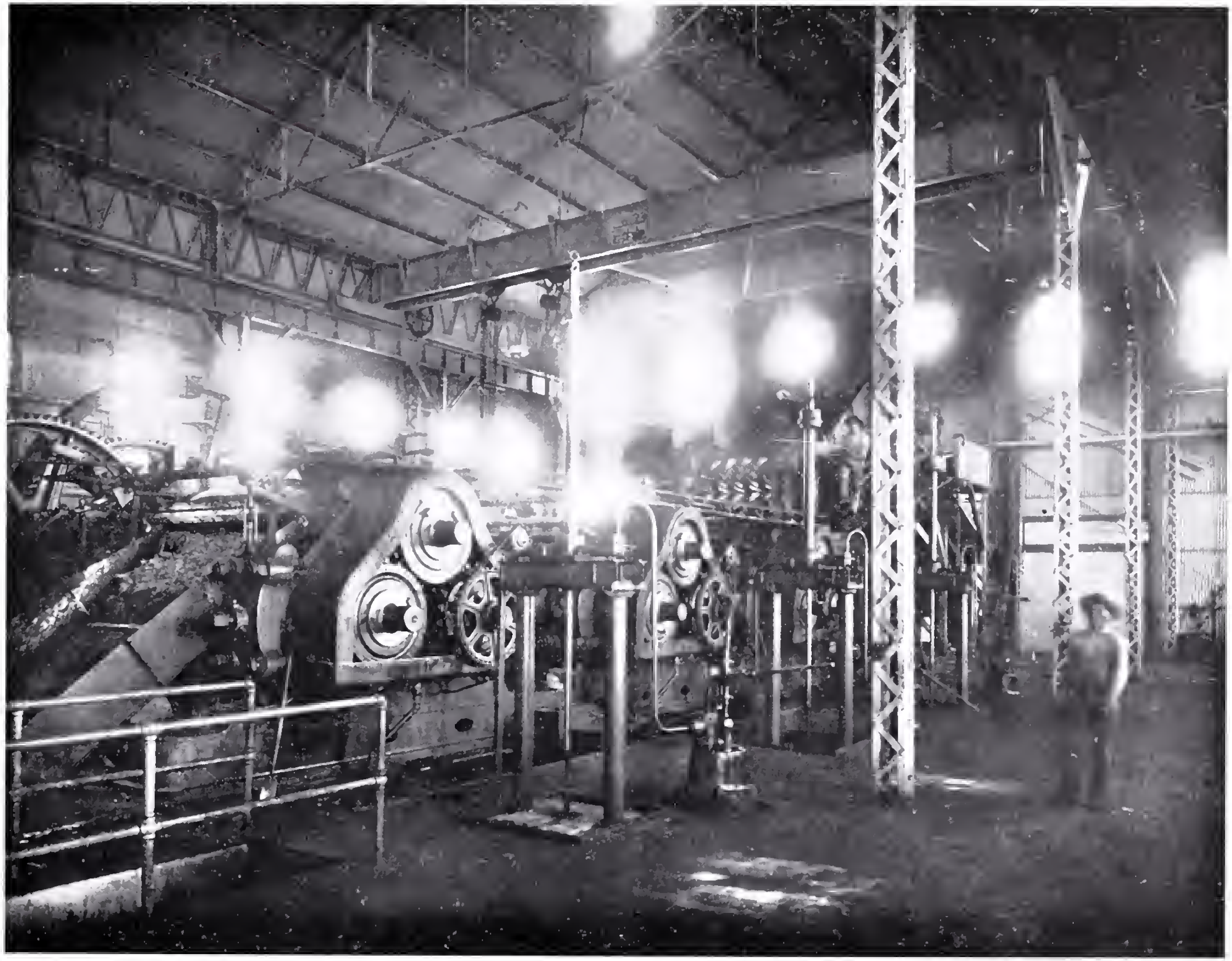


STEEL WORK DESIGNED, FURNISHED AND ERECTED BY MILLIKEN BROTHERS.

Oahu Sugar Co. Cane Carrier Shed, Honolulu, H. I.



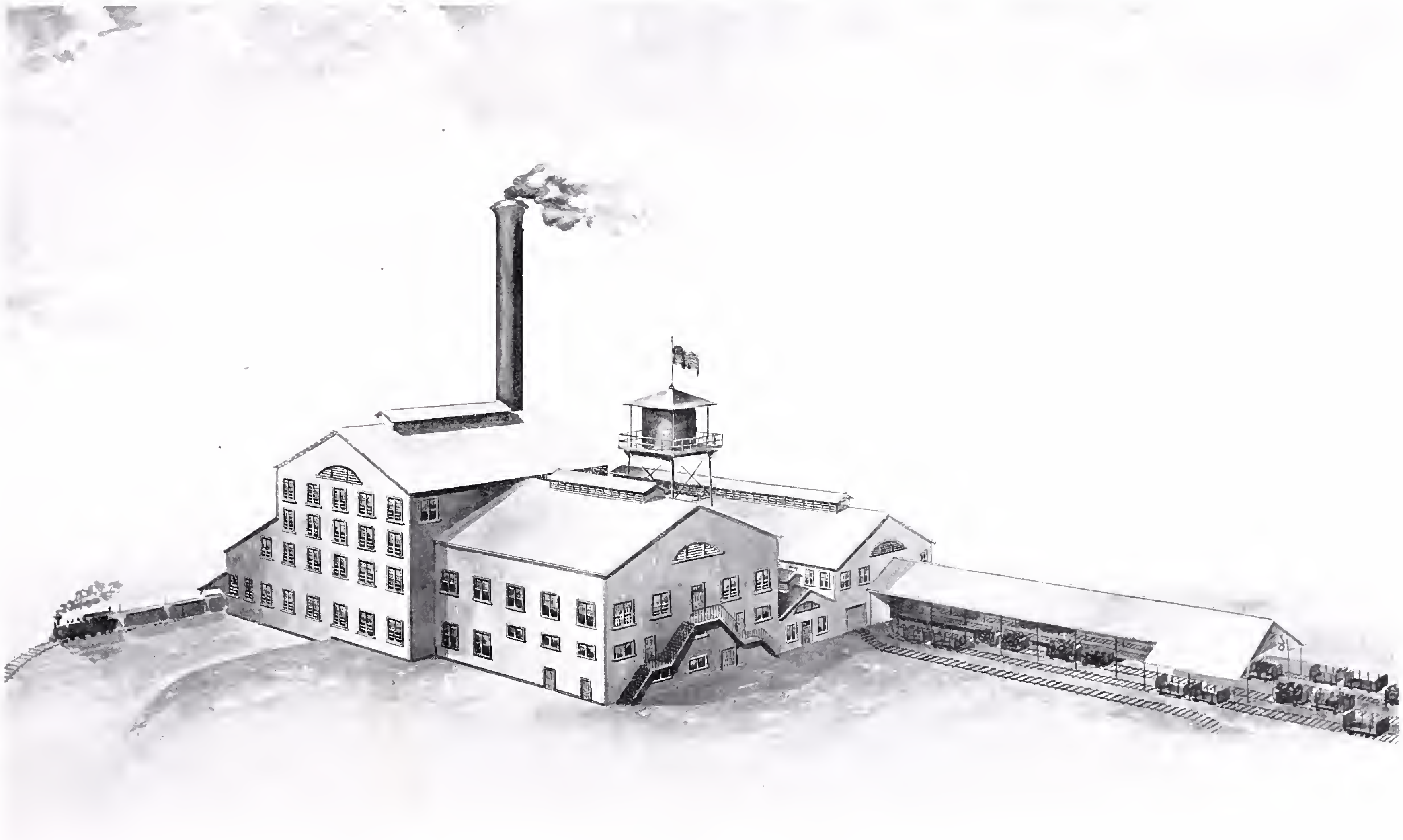
STEEL WORK DESIGNED, FURNISHED AND ERECTED BY MILLIKEN BROTHERS.



STEEL WORK DESIGNED, FURNISHED AND ERECTED BY MILLIKEN BROTHERS.

Oahu Sugar Co. Crystallizer and Centrifugal Floors, Honolulu, H. I.

STEEL WORK DESIGNED, FURNISHED AND ERECTED BY MILLIKEN BROTHERS.



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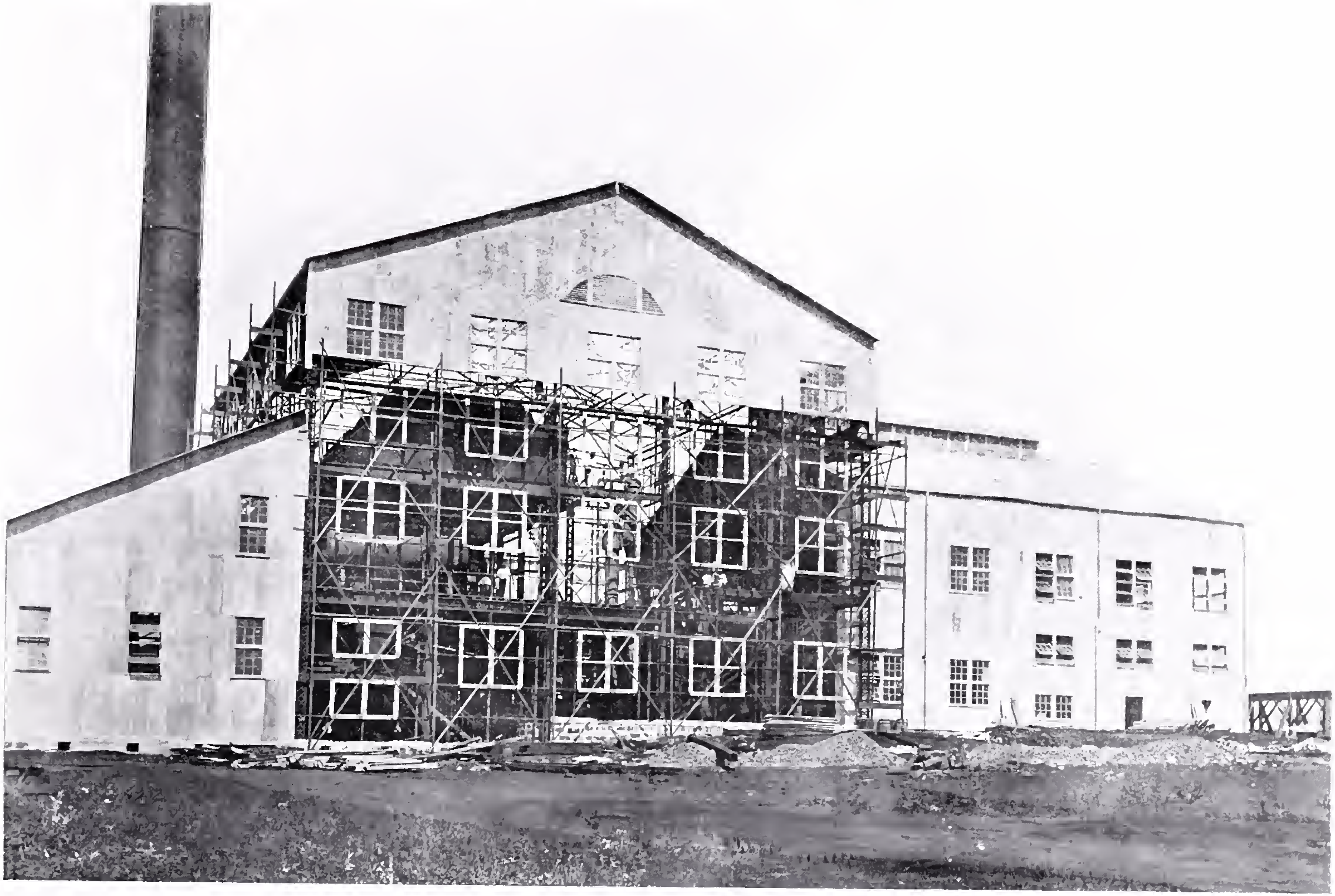
STEEL WORK DESIGNED, FURNISHED AND ERECTED BY MILLIKEN BROTHERS.

Waialua Sugar Mill, Hawaiian Islands.



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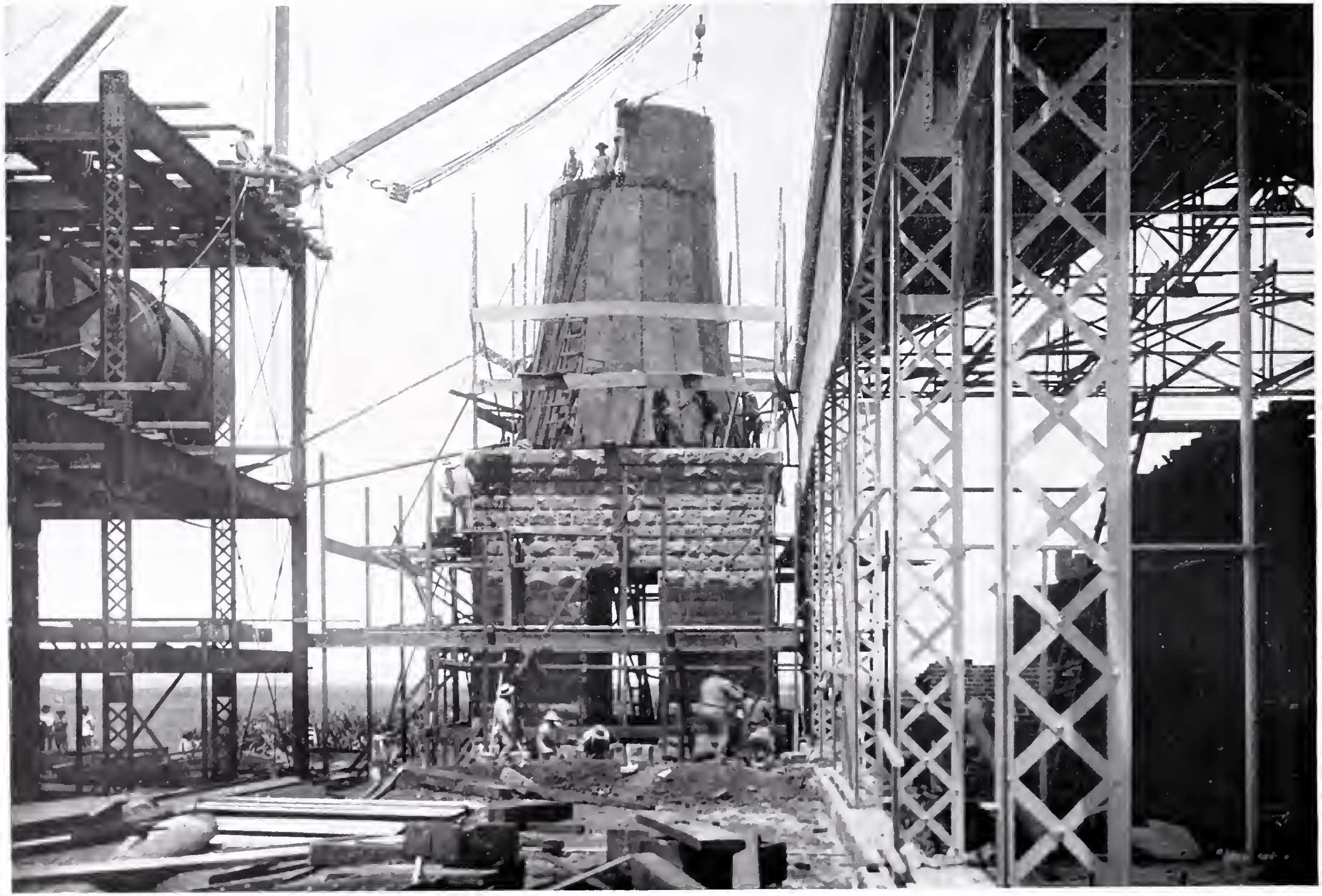

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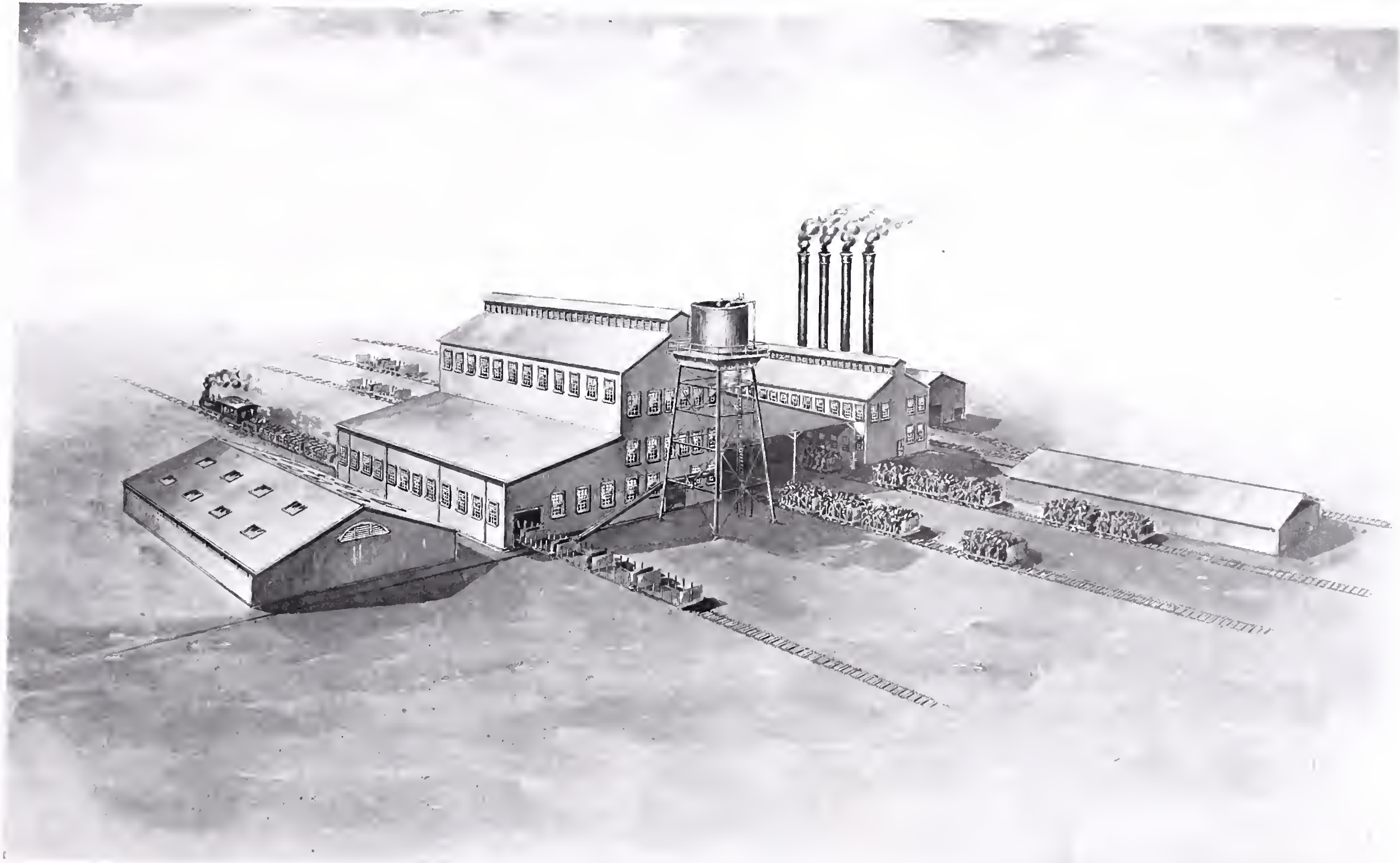

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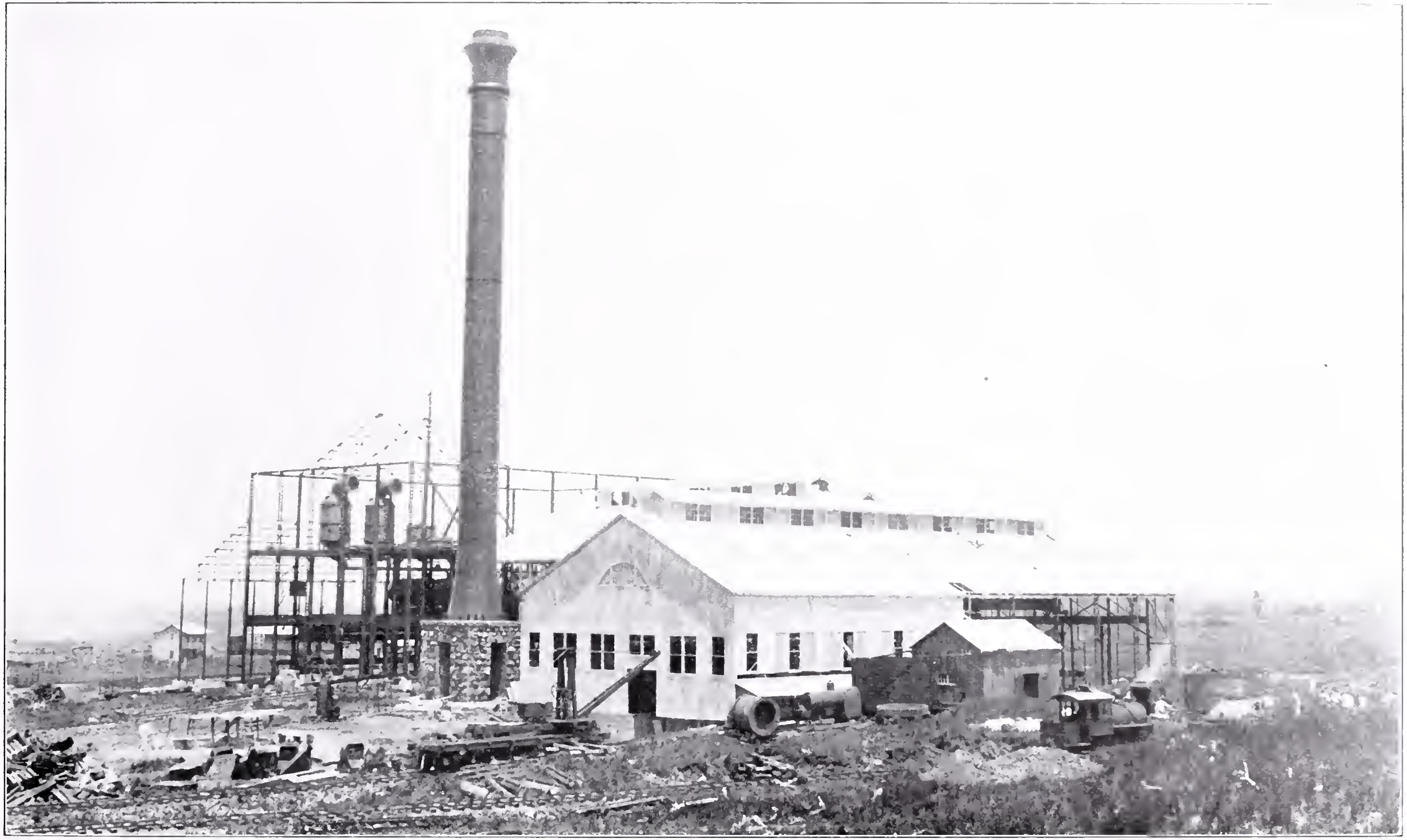

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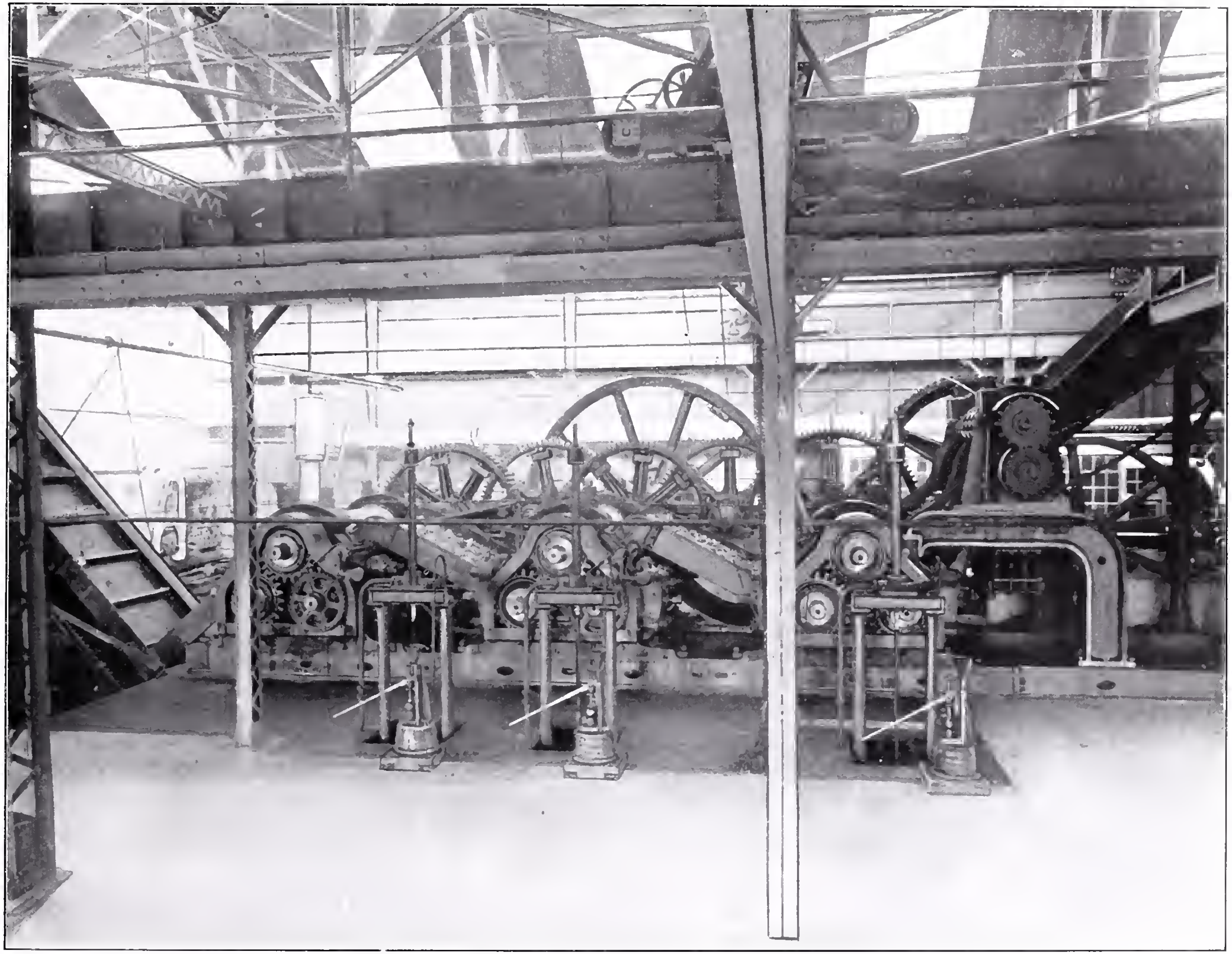
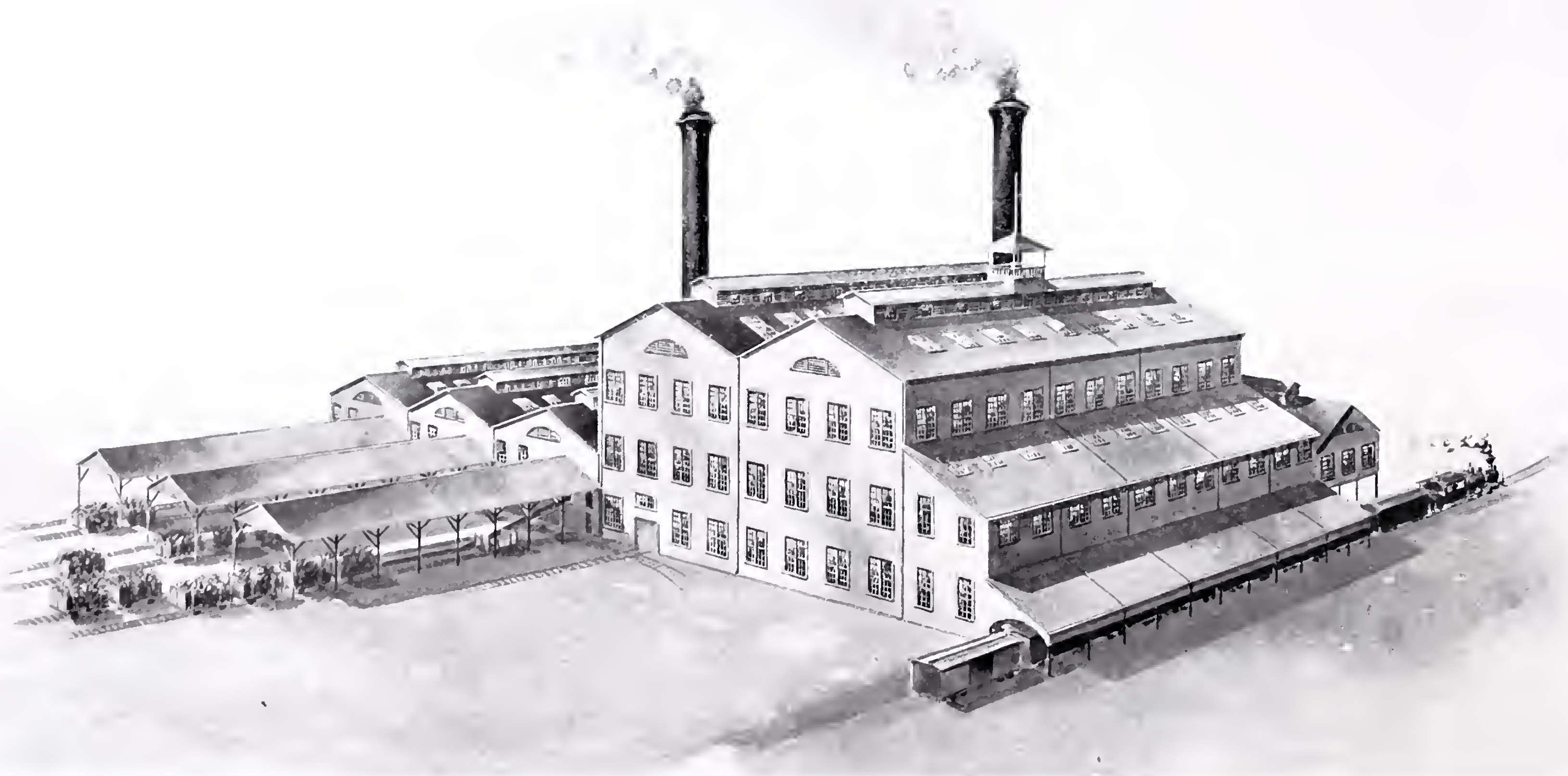
STEEL WORK DESIGNED, FURNISHED AND ERECTED BY MILLIKEN BROTHERS.

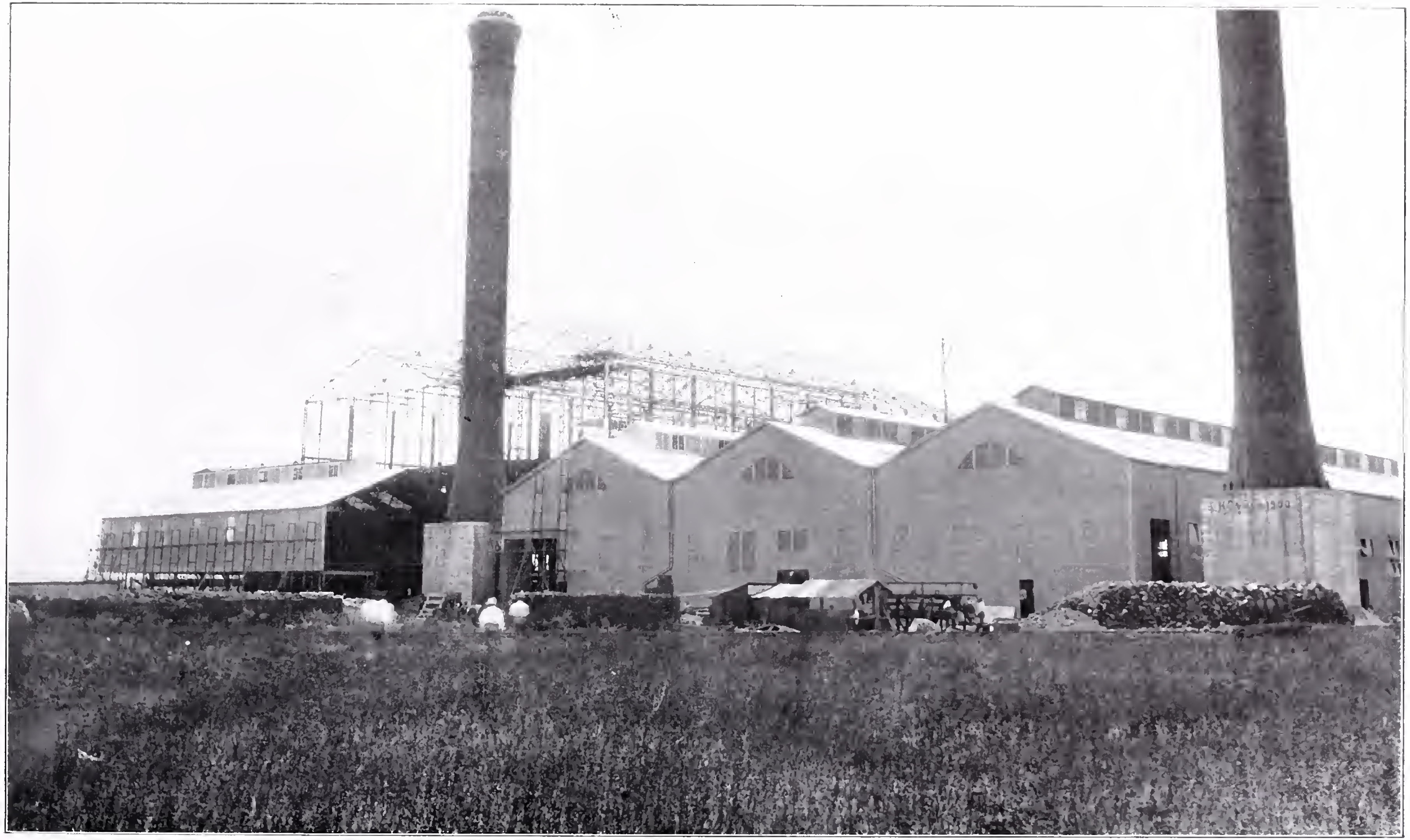
Olaa Sugar Mill, Hawaiian Islands, Showing Crushing Plant.



STEEL WORK DESIGNED, FURNISHED AND ERECTED BY MILLIKEN BROTHERS.

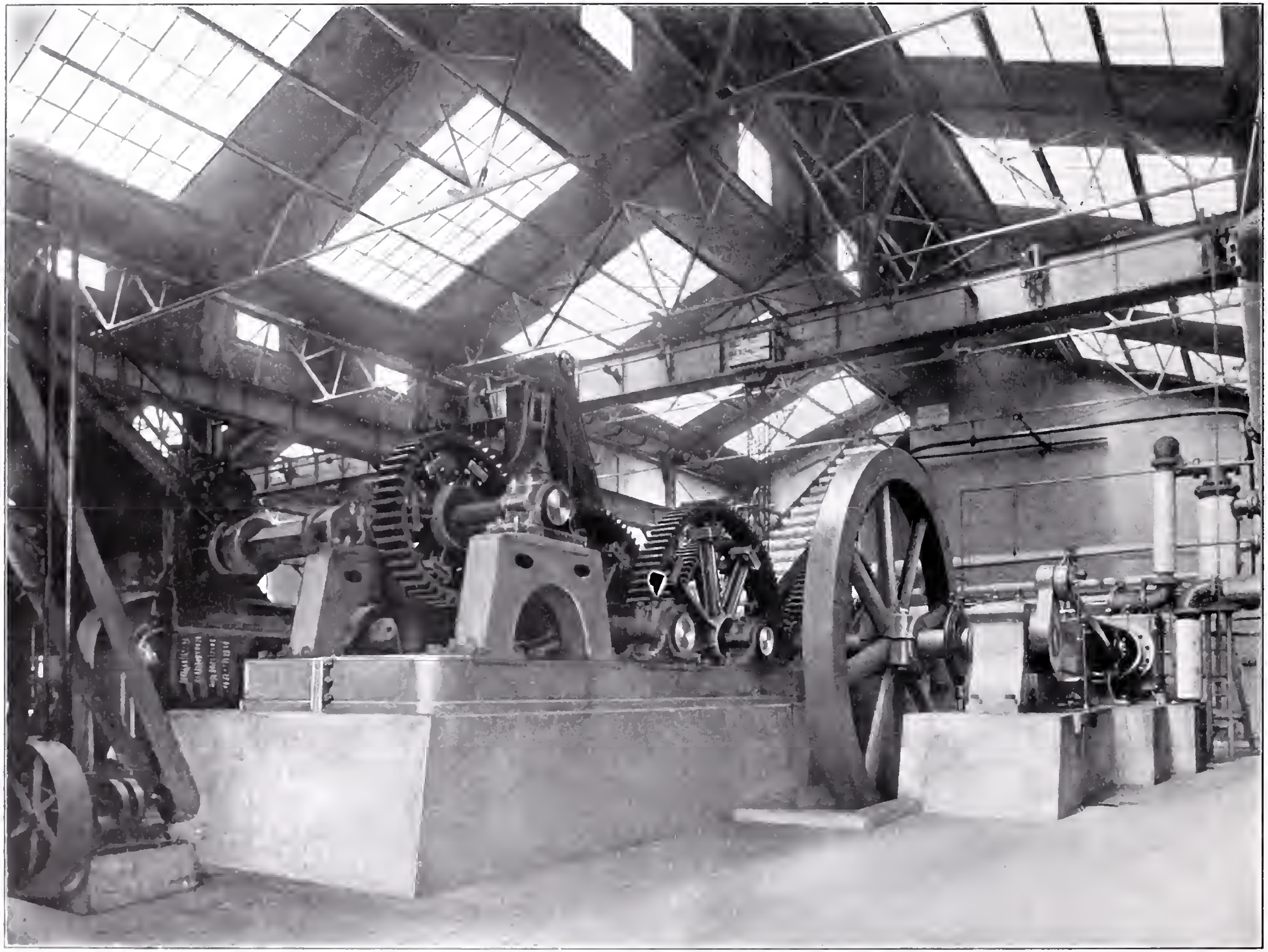


Steel work designed, furnished and erected by Milliken Brothers.



STEEL WORK DESIGNED, FURNISHED AND ERECTED BY MILLIKEN BROTHERS.

HAWAIIAN COMMERCIAL AND SUGAR COMPANY'S PLANT, H. I., SHOWING CRUSHING MILLS.

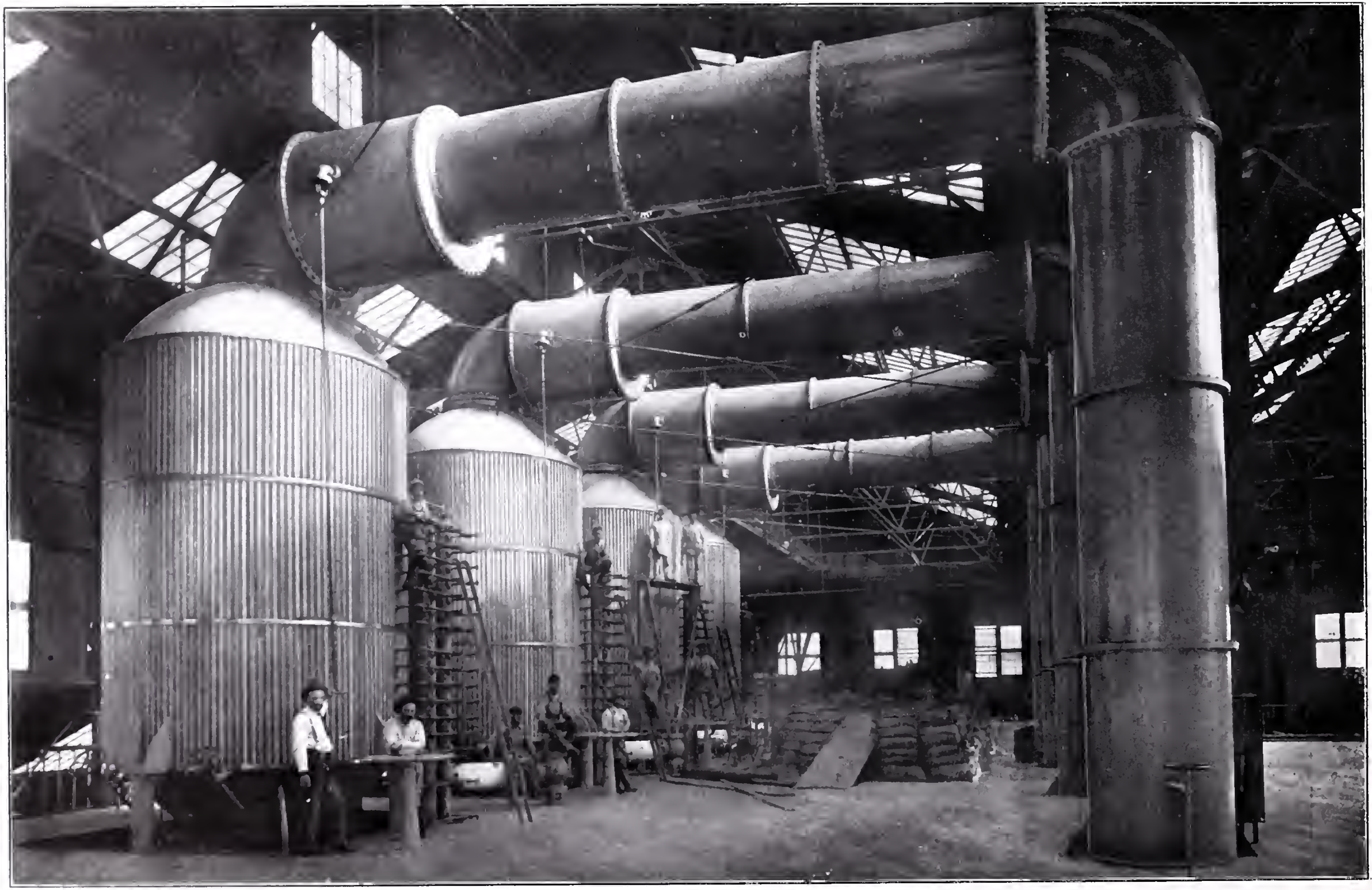


STEEL WORK DESIGNED, FURNISHED AND ERECTED BY MILLIKEN BROTHERS.

Hawaiian Commercial and Sugar Company's Plant, Hawaiian Islands, Showing Shipping Shed.

STEEL WORK DESIGNED, FURNISHED AND ERECTED BY MILLIKEN BROTHERS.

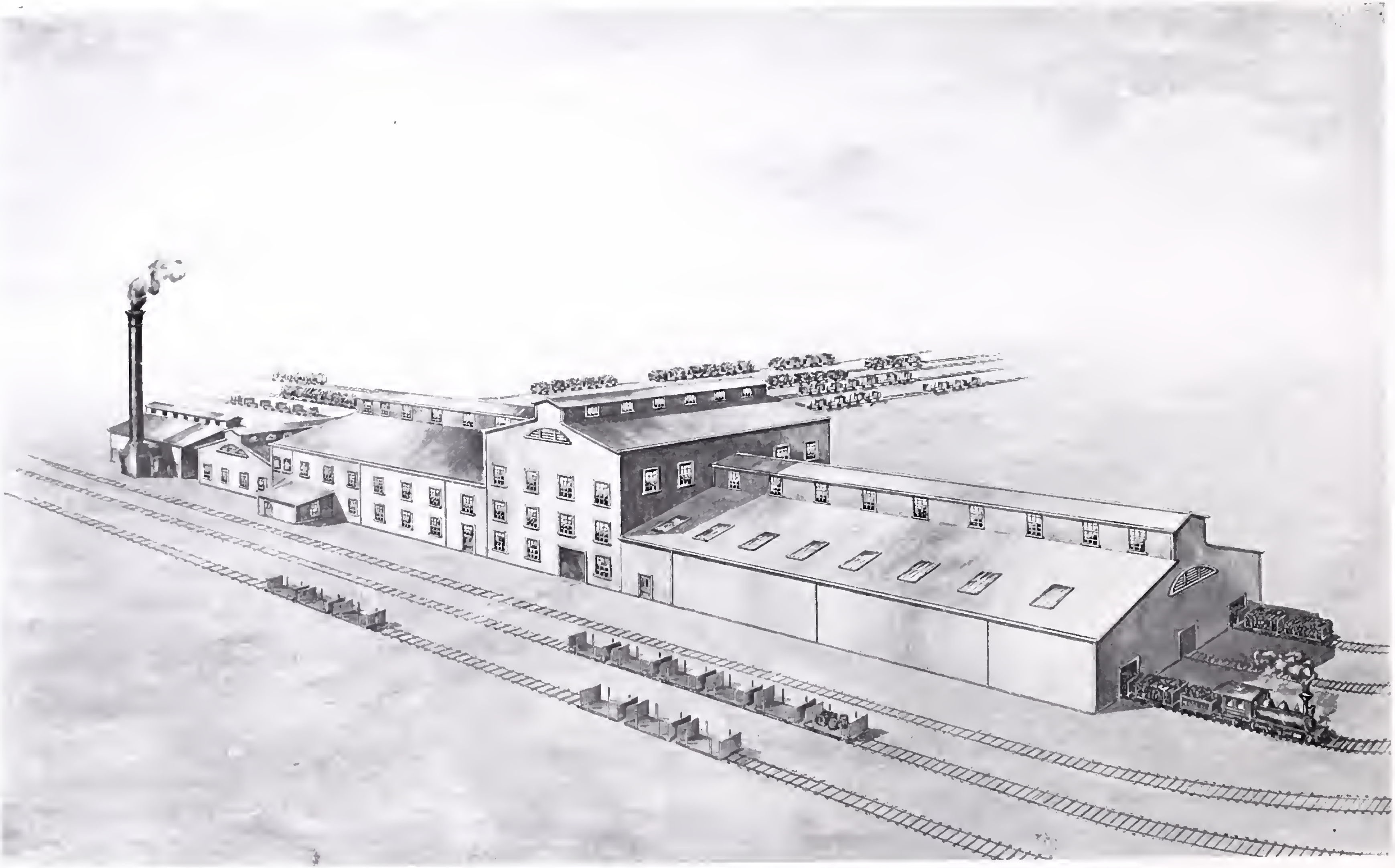
Hawaiian Commercial and Sugar Company's Mill, Strike Pan Floor.



STEEL WORK DESIGNED, FURNISHED AND ERECTED BY MILLIKEN BROTHERS.

HAWAIIAN COMMERCIAL AND SUGAR COMPANY'S SUGAR MILL, HAWAIIAN ISLANDS.

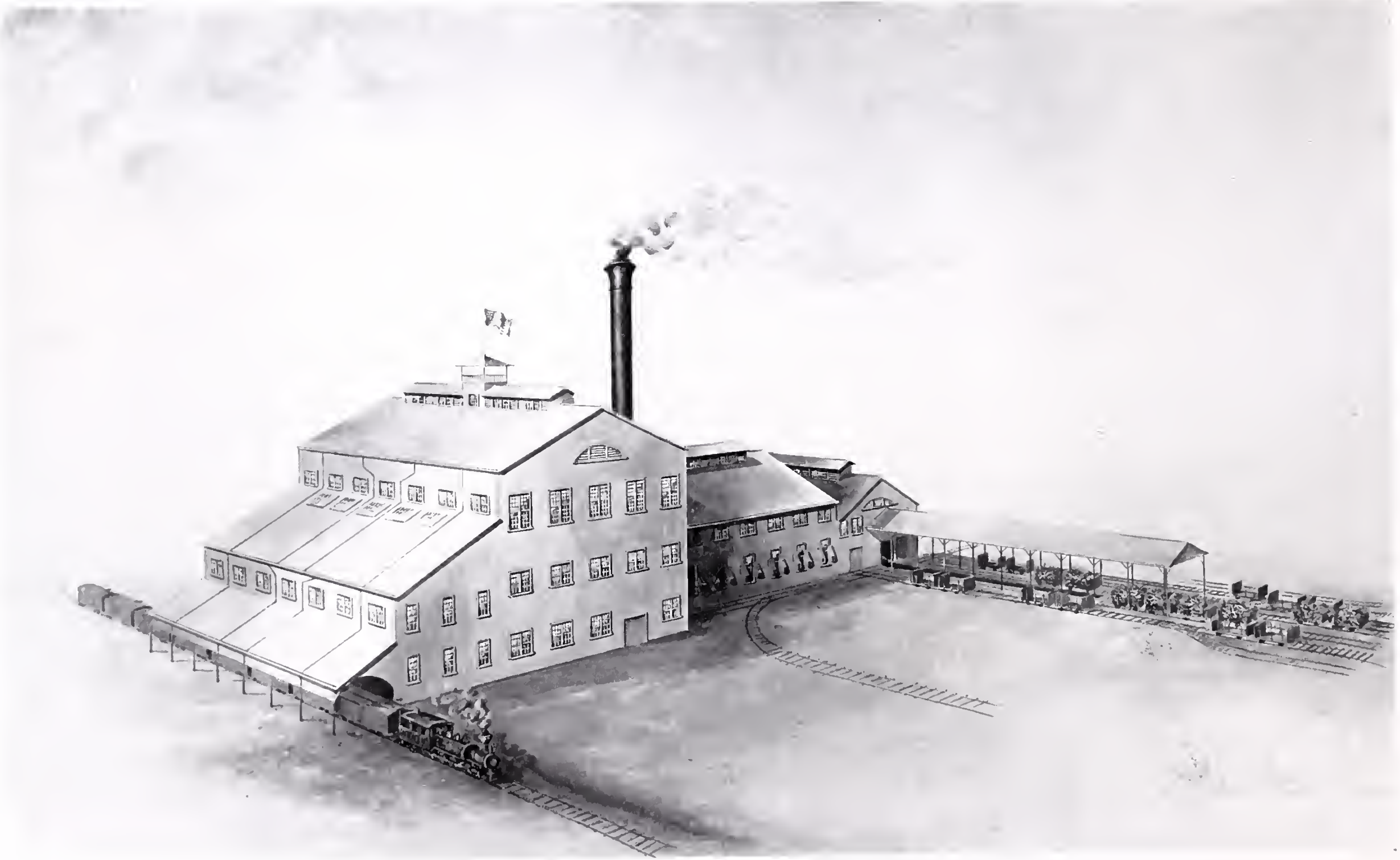
STEEL WORK DESIGNED, FURNISHED AND ERECTED BY MILLIKEN BROTHERS.



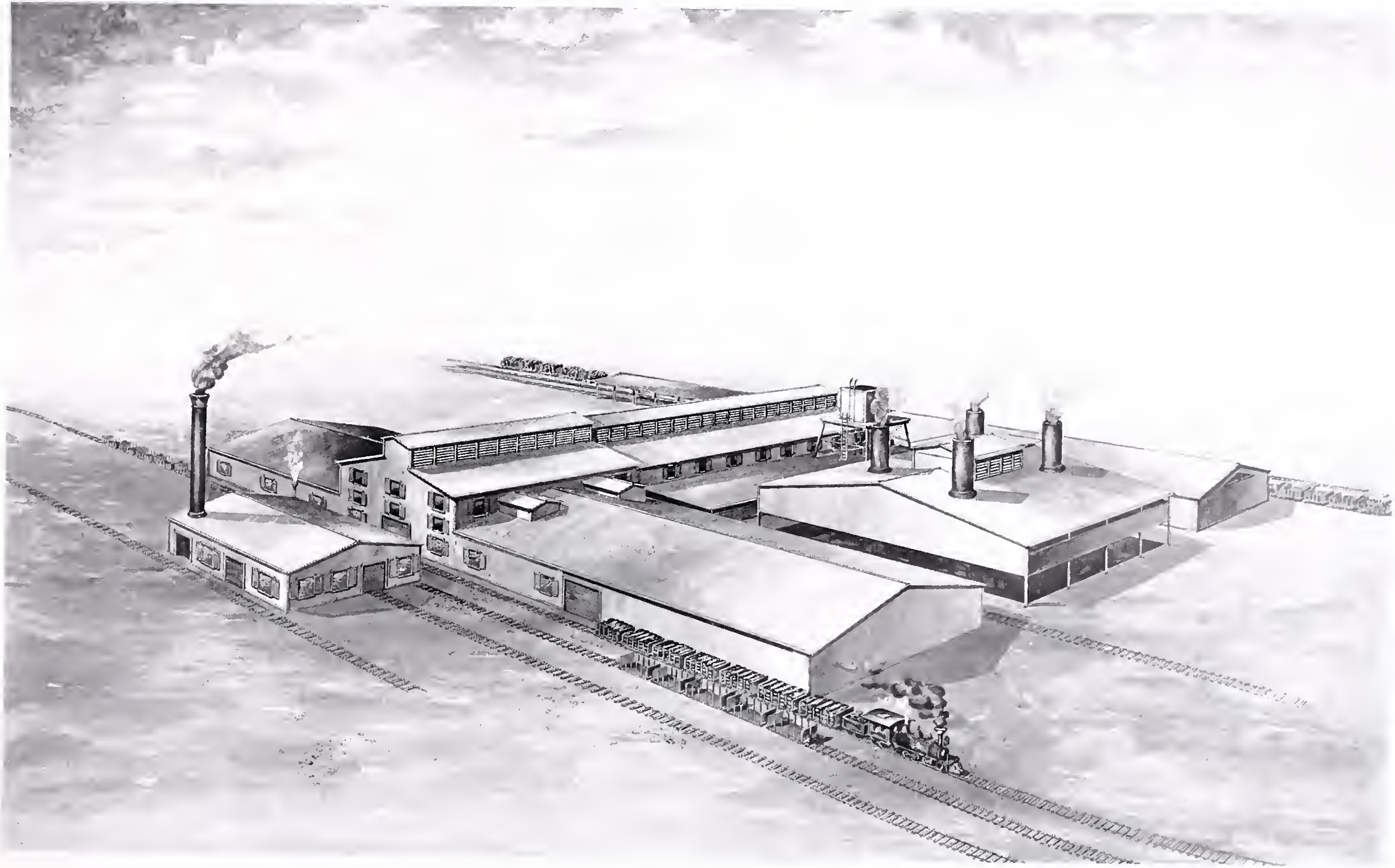
Steel work designed and furnished by Milliken Brothers.

MAKEE SUGAR COMPANY'S SUGAR MILL PLANT, HAWAIIAN ISLANDS.

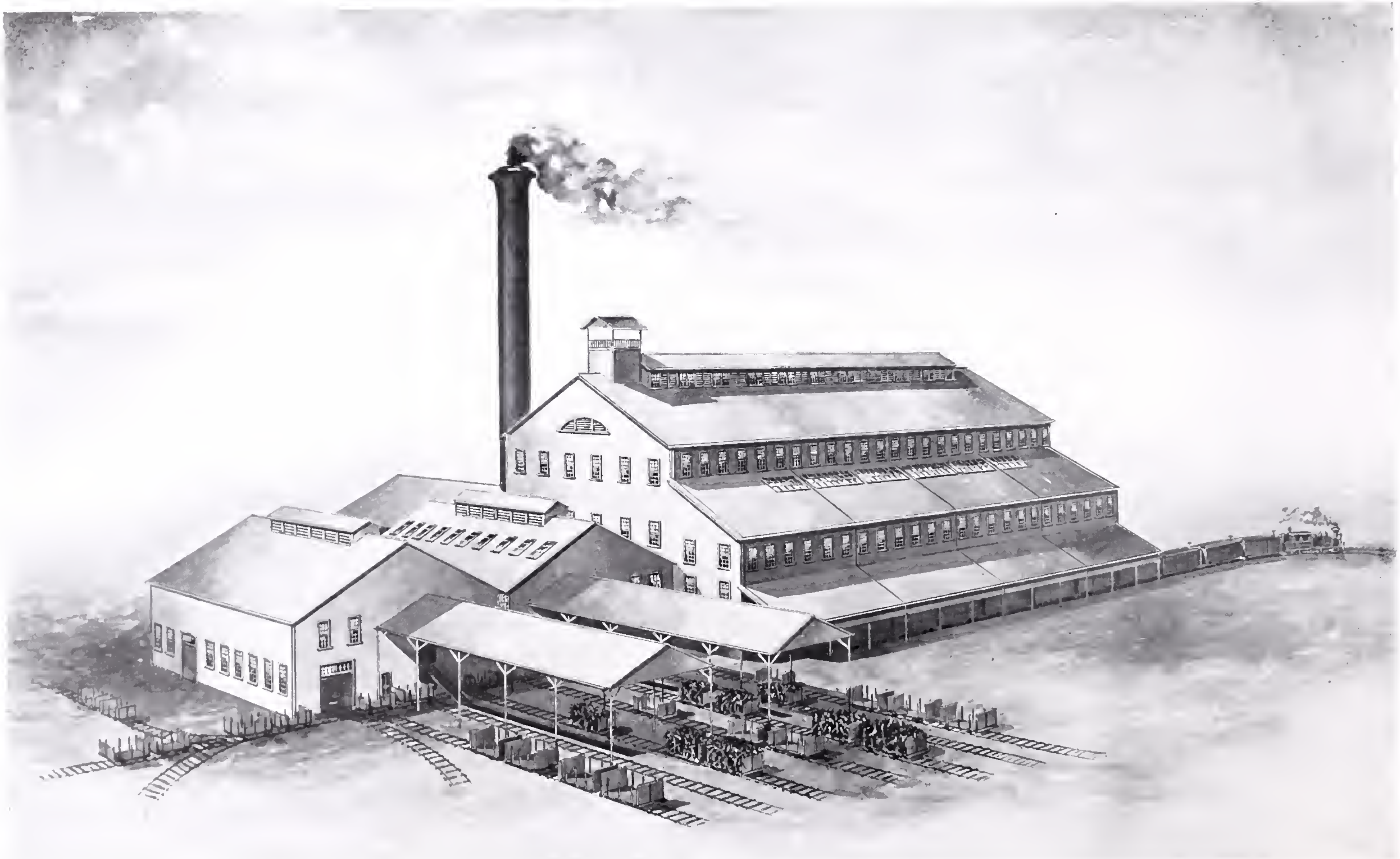
STEEL WORK DESIGNED AND FURNISHED BY MILLIKEN BROTHERS.



STEEL WORK DESIGNED, FURNISHED AND ERECTED BY MILLIKEN BROTHERS.

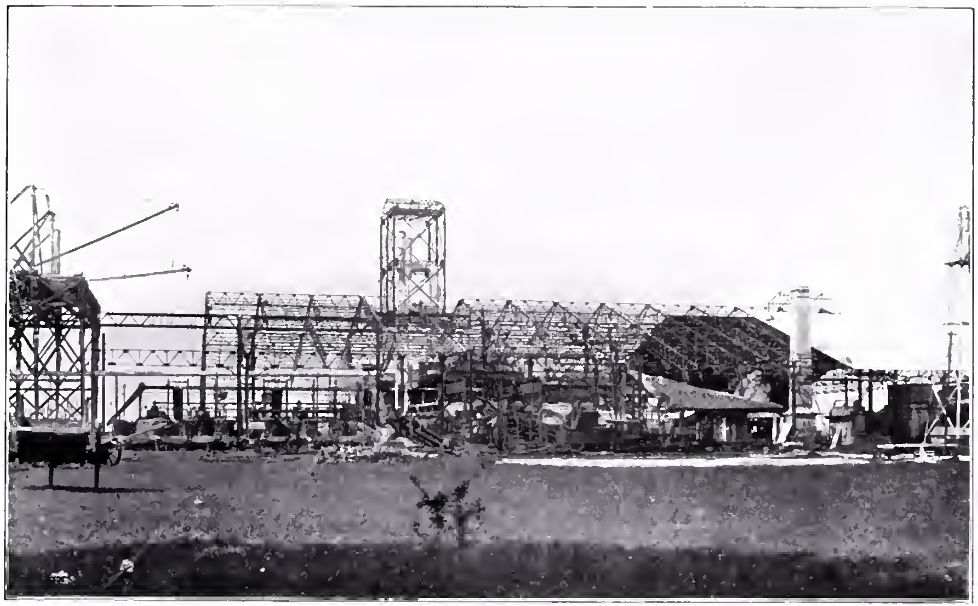


Steel Work Designed and Furnished by Milliken Brothers.



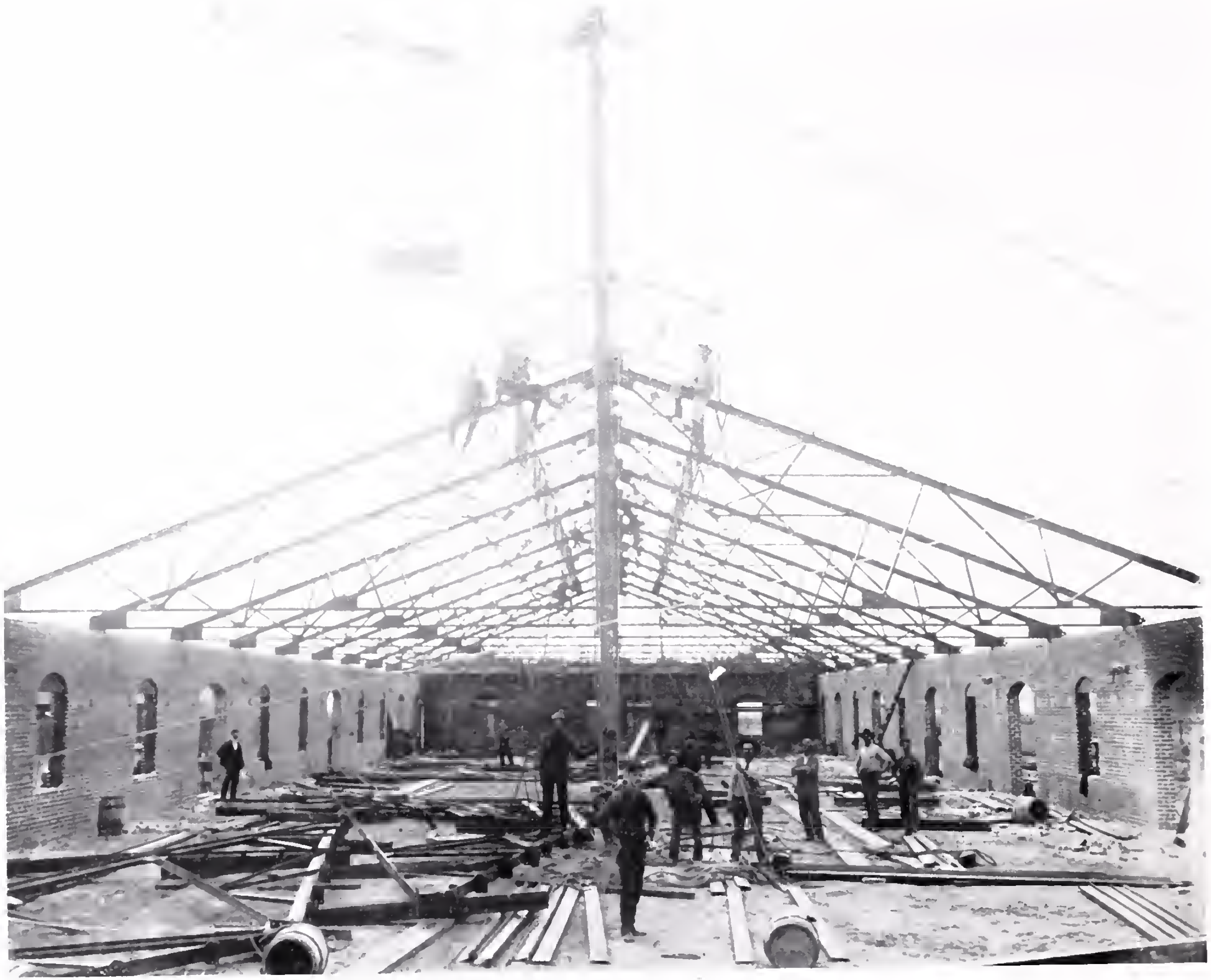
STEEL WORK DESIGNED, FURNISHED AND ERECTED BY MILLIKEN BROTHERS.

YNGO ELIZALDE, CUBA.



STEEL WORK DESIGNED, FURNISHED AND ERECTED BY MILLIKEN BROTHERS.

AMERICAN BEET SUGAR CO. BOILER HOUSE, CHINO VALLEY, CAL.

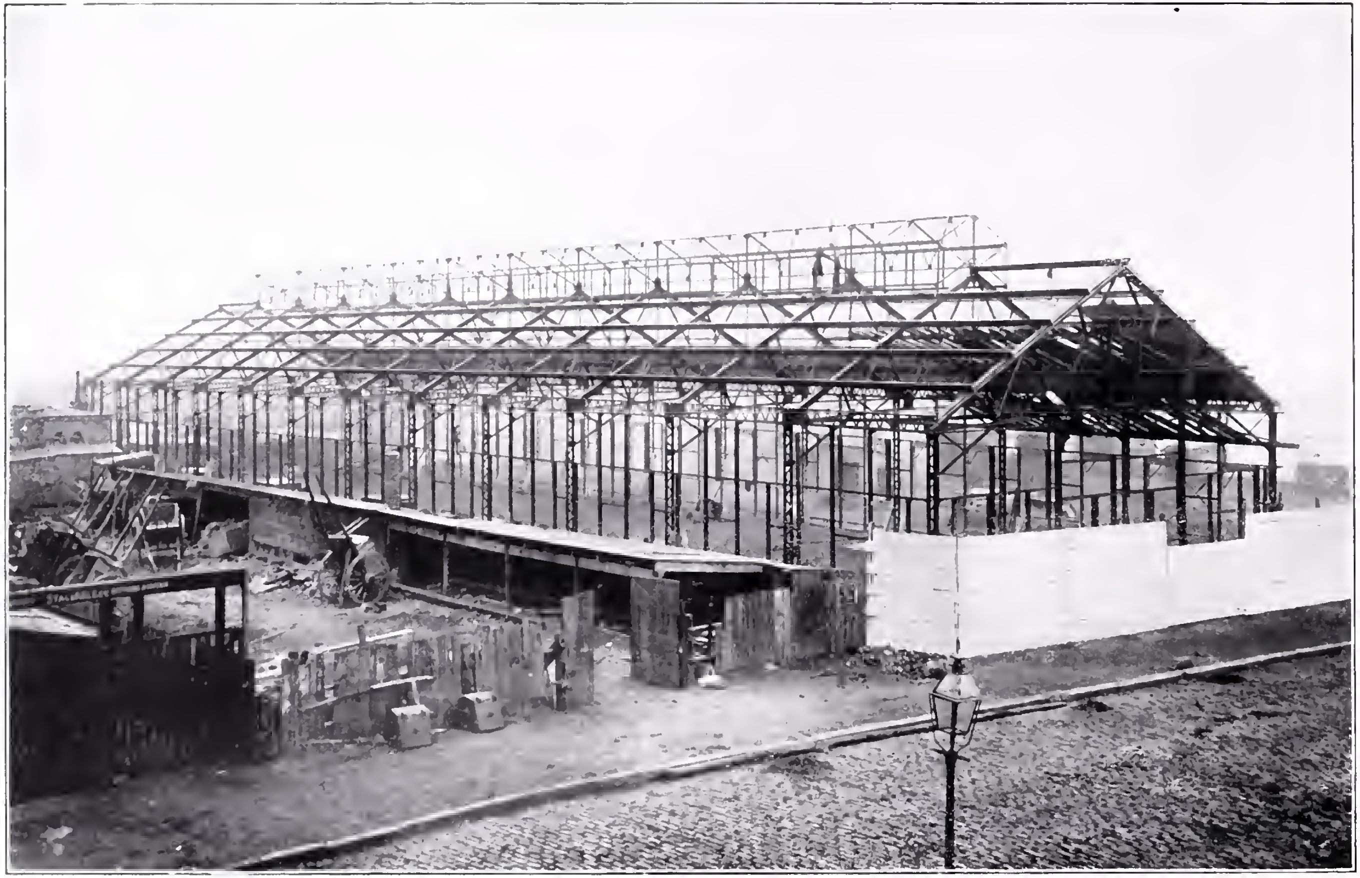


STEEL WORK DESIGNED AND FURNISHED BY MILLIKEN BROTHERS.

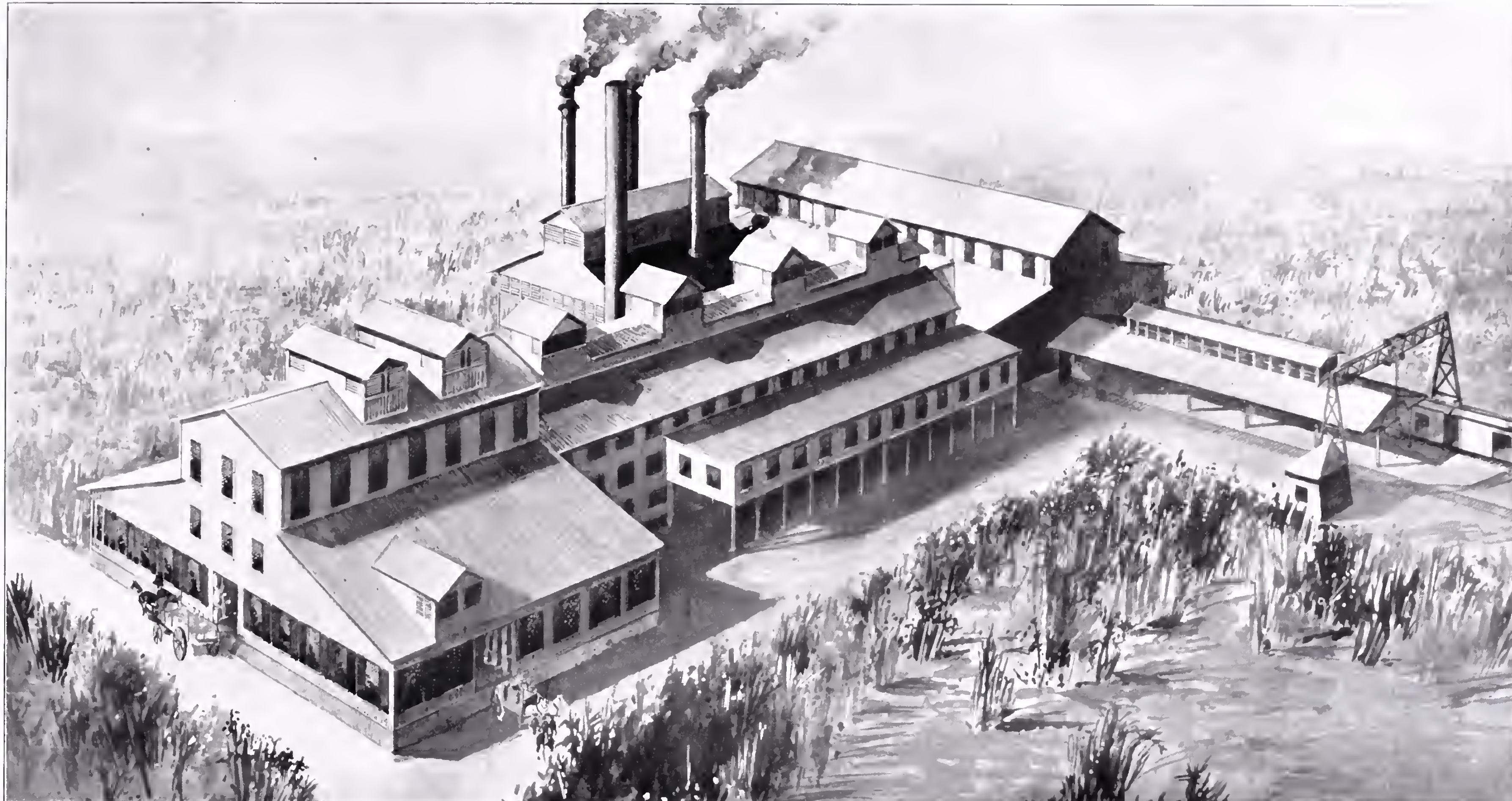
Warehouse, West 58th Street, New York City.

STEEL WORK DESIGNED, FURNISHED AND ERECTED BY MILLIKEN BROTHERS.

WAREHOUSE, WEST 58TH STREET, NEW YORK CITY.



STEEL WORK DESIGNED, FURNISHED AND ERECTED BY MILLIKEN BROTHERS.



STEEL WORK DESIGNED AND FURNISHED BY MILLIKEN BROTHERS.

SHEET METAL WORK.

The use of corrugated Galvanized Sheet Iron is becoming very general in Foreign Countries, owing no doubt to the fact of its very extensive use in this country. Plate No. 50 gives the thickness in inches and m/ms. for the corresponding gauge number as used in the United States. In specifying for sheet iron work the gauge number represents the thickness of the iron before it is galvanized. After it is galvanized it will increase in thickness about one-half the difference between the numbers given, for instance No. 22 United States Standard when galvanized will be intermediate in thickness between No. 20 and No. 22 before it is galvanized.

The center part of Plate No. 50 gives the distance center to center of the corrugations, and also the approximate depth of the corrugations which, however, is liable to change slightly. In specifying for corrugated sheet iron the distance from center to center of corrugations is always given and not the depth of the corrugations. For instance in specifying for the second one shown in illustration one should specify for 63.50 $^{m}/_{m}$ which would correspond with the 2½ inches English corrugation and this, by the way, is the one which is most commonly used in the United States and the one which we find gives the greatest amount of strength and rigidity, as well as security in keeping out the water. The 3 inch English (76.20 $^{m}/_{m}$) corruga-

tion is not very often used and the $1\frac{1}{4}$ inches English ($31.75\ ^{m}/_{m}$) is usually used for ornamental doors and finishing work of this kind. The same with the $\frac{5}{8}$ inches English ($15.88\ ^{m}/_{m}$).

Plate No. 50 gives the standard covering capacity in width of the sheets when laid on the roof. Some parties desire to lap the corrugations on the side two full corrugations instead of one as shown on this Plate. In this case of course the covering capacity of the sheets is reduced that much. The advantage gained is that the chance of the water beating in over the top of the end or seamed corrugation is of course much less. The sheets as carried in stock are given on this plate but intermediate lengths can always be had if time is given to cut them. When the lengths of sheets are not specified we always send sheets 8 feet net or 2.44^{m} long.

As the depth of the corrugation is likely to vary, in ordering any corrugated iron through Commission Houses customers should be very careful to inform them that the same must be furnished by Milliken Bros. in order that the corrugations of the sheets furnished may match those originally shipped.

FIGURE 8.

The corrugated sheet iron is attached to the purlins by different methods. Figure 8 shows a very common way of attaching the sheet iron to the purlin, by means of what we call a clip. We do not recommend this in the least because it allows the sheet to spring and in time it may become loose. Figure 9 and Figure 10 represent other ways of executing the work, in which the clip is passed partially around the purlin, but the method recommended by us and invariably used by us is shown in Figure 11, in which the clip passes entirely around the purlin and is fastened at both ends. Figure 11. shows an angle purlin but the same principle is used no matter what shape the purlin is. The clip is a narrow band of galvanized iron and is riveted to the underside of the top of the corrugation, not to the valley or bottom of the corrugations.

FIGURE 9.

FIGURE 10.

FIGURE 11.

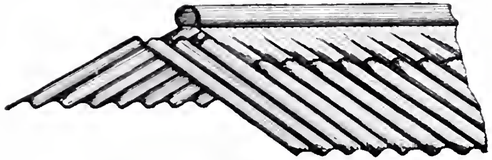


FIGURE 12.

The ridge or apex of the roof is usually covered by a ridge roll or capping piece, which closes the joint between two sheets. This is shown on Figure No. 12. This cap is made in one piece and the edges are hammered down into the corrugations to form a water tight joint. The gutters are made in a number of different shapes. Figure 13 gives dimensions of various kinds of half round gutters, the size of course depending upon the area of the roof which has to be taken care of.

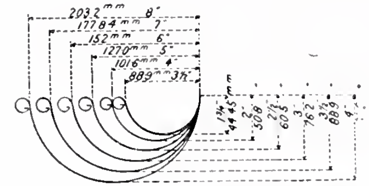


FIGURE 13.

FIGURE 14.

Figure 14 gives a general view of this form of gutter. Figure 15 shows the round gutter with the corrugated iron, the arrangement of the end of the gutter and of the leader connecting with the gutter. Figure 16 shows a more ornamental form of gutter and Figure 17 a still more ornamental one. This last named makes a very nice finish and handsome appearance at the eaves of the roof.

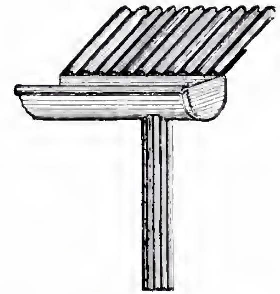


FIGURE 15.

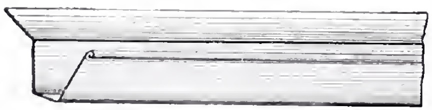


FIGURE 16.

Figure 18 represents the flashing which is used in a variety of forms at any point where two pieces of sheet iron meet at different angles, or where corrugated iron connects with a brick wall. A piece of flashing is shown underneath a window in Figure 20. Although not shown in illustration in this catalogue, we are prepared to furnish all kinds of

FIGURE 17.

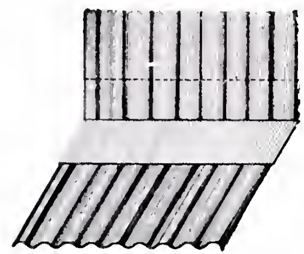


FIGURE 18.

wooden windows and doors for factory buildings. Windows as usually constructed in this country have two sashes, which are counterbalanced by weights running over a pulley, so that the lower or upper sash can be raised or lowered with little exertion. We furnish these windows complete with their sashes, frames, weights, cords, pulleys, locks and glass. The outside frames in sheet iron buildings should be covered with plain galvanized sheet iron, similar in construction to the casing as shown on Figure 19. Figure 19 shows the construction of what are called corner boards or base boards, which are wooden pieces covered with plain galvanized sheet iron to make a finish for the corrugated iron. Sashes in the monitors of buildings used for admitting light and securing ventilation are occasionally furnished with sliding sash, but we much prefer to use the form as shown in Figure 20. This sash is pivoted in the centre and is operated from the floor by means of a worm and gear. This arrangement prevents the sash from opening during a wind storm, and in closing allows the operator to bring the sash tight against the frame, so as to prevent water getting in.

In specifying for doors, we recommend on account of the ease of shipping, erection and the fire-proof qualities, rolling steel shutter doors, which are arranged with a spring over the top and roll

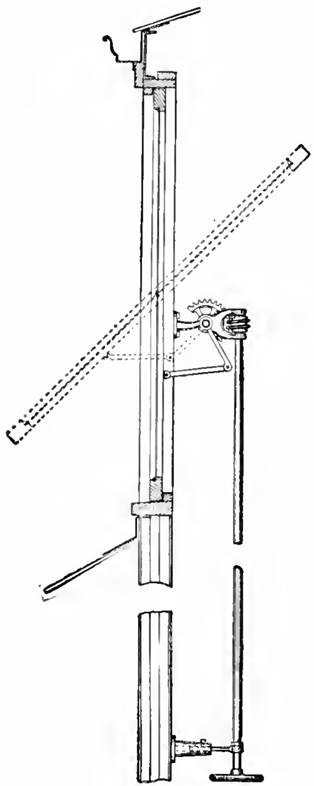


FIGURE 20.

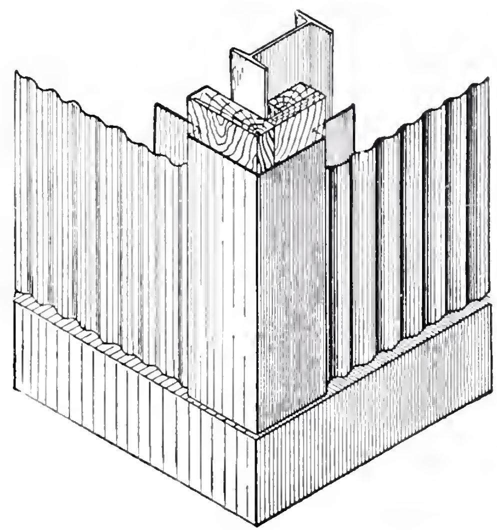


FIGURE 19.

FIGURE 21.

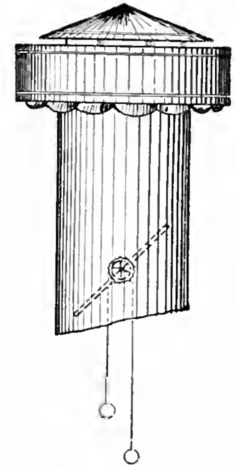


FIGURE 22.

upwards, leaving a clear passageway for the entrance of goods as detailed on Plate 51. Figure 21 shows two of these doors. On the left hand side the door is closed and on the right hand the door is rolled up above the door opening and always completely out of the way nor is it ever subject to damage by wind.

It is absolutely necessary in sheet iron buildings, owing to the changing of the temperature of the outside air, and to prevent condensation of water on the inside surface of the sheet iron, to provide ample and sufficient ventilation. This entirely prevents condensation of moisture. In buildings having monitors it is easy to open and close the windows in the sides, but in buildings which are not provided with monitors, arrangements must be made to ventilate the same. Figure 22 shows such a ventilator with a damper which can be opened and closed from the floor.

For the admission of light in buildings of this class we furnish several different kinds of skylights. Figure 23 shows a plain flat skylight without any apparatus. Figure 24 shows a hipped skylight

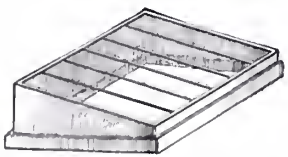


FIGURE 23.

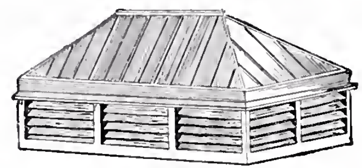


FIGURE 24.

in which the sides are composed of slat louvres and the roof is covered with glass. These slat louvres are often made very large and are provided with an apparatus to permit of their being opened and closed. These are called movable louvres. When they are not arranged to open and close they are called fixed louvres. The sides of monitors are often made with this form of construction to allow the free access of air, but of course these louvres admit

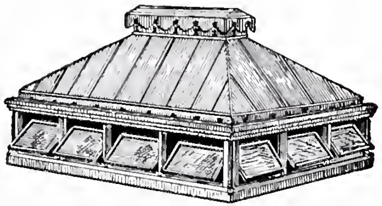


FIGURE 25.

very little if any light. Figure 25 shows a skylight with a glass roof, arrangement on the extreme top for ventilation; and the sides formed with pivoted glass sashes.

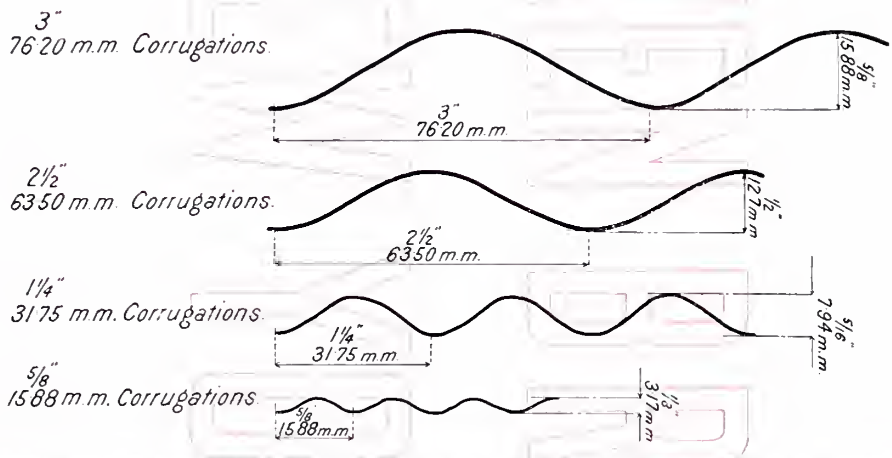
Plate No. 52 shows a special form of construction of roof particularly adapted for the manufacture of textile goods where a large amount of light is required. This also provides for the usual ventilation above the sashes, and in cases where more ventilation is required the glass sashes are pivoted and can be operated as shown on Figure 20.

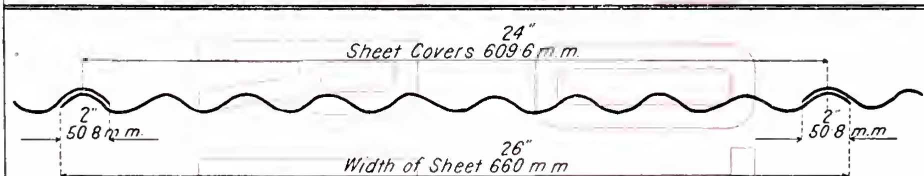
FIGURE 26.

Figure 26, shows a building of the Atlas Cement Co. nearly completed and covered with corrugated galvanized sheet iron. The structural steel work during construction is shown in a photograph in another part of this catalogue. A very good idea of a sheet iron building adapted to light manufacturing work is shown in the two photographs in this catalogue entitled "Eastman Company's Building," the first one of the structural steel framework, and the second of the building as finally completed and covered with corrugated sheet iron.

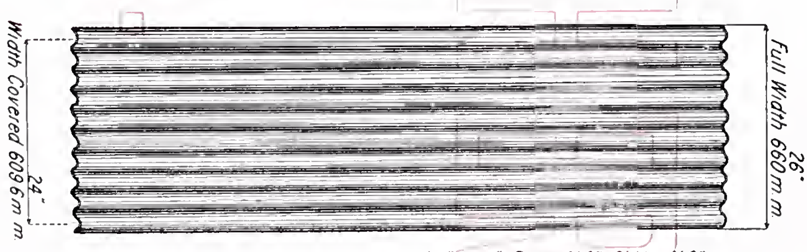
Corrugated Iron before being galvanized.

Gauge	Thickness		Gauge.	Thickness	
Number 28 U.S.	·40 m m	·0156"	Number 20 U.S.	·95 m.m.	·0375"
" 26 "	·48 "	·01875"	" 18 "	1·27 "	·05"
" 24 "	·64 "	·025"	" 16 "	1·59 "	·0625"
" 22 "	·79 "	·0312"			





Section of Sheet having 2½" 63·50 m.m. Corrugations.



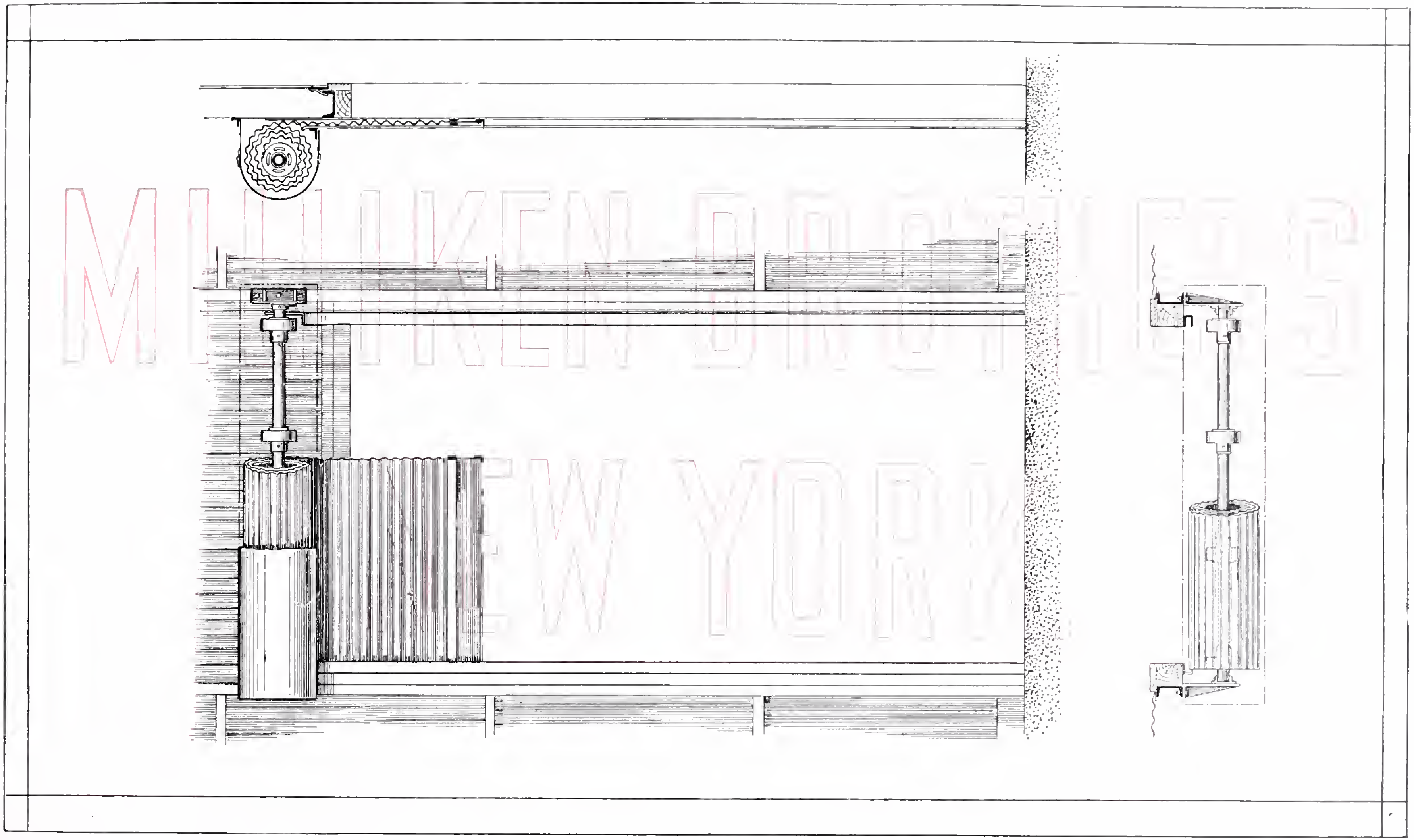
Stock Sheets, standard lengths 5'·0" 1·52m, 6'·0" 1·83m, 7'·0 2·13m, 8'·0" 2·44m, 9'·0" 2·74m, 10'·0" 3·04m

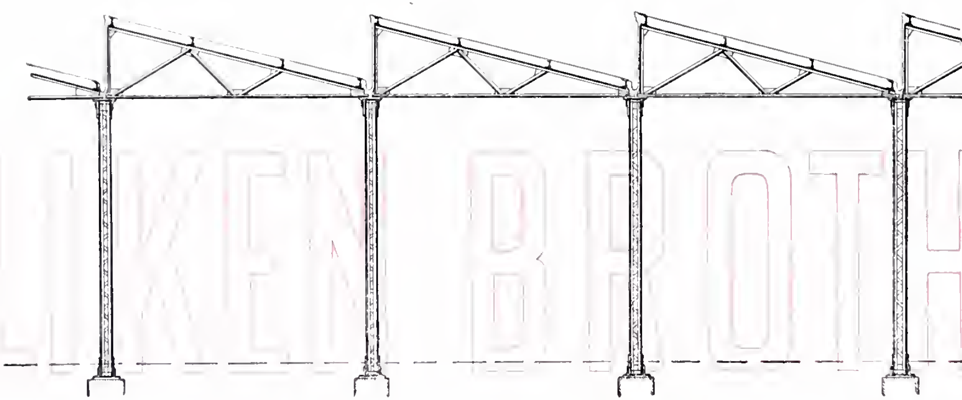
If no length is specified we send sheets 8'·0" 2·44m long

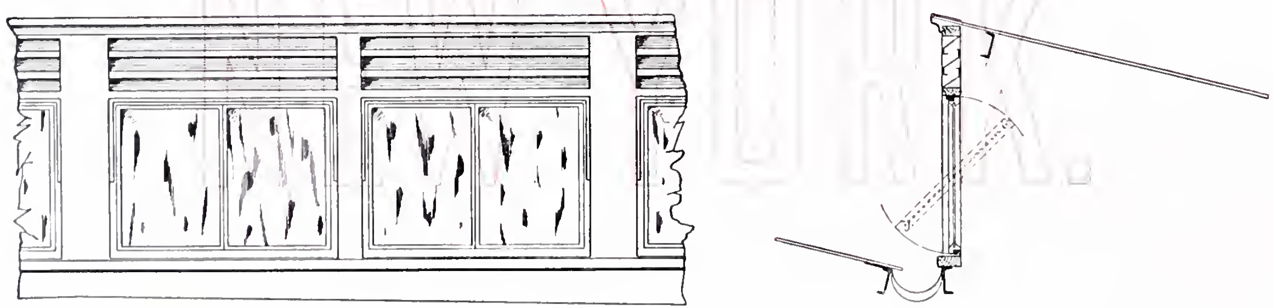
All sheets of all Gauges have uniform Width

The full Width is 26" 660 m m – The width Covered is 24" 609·6 m.m.

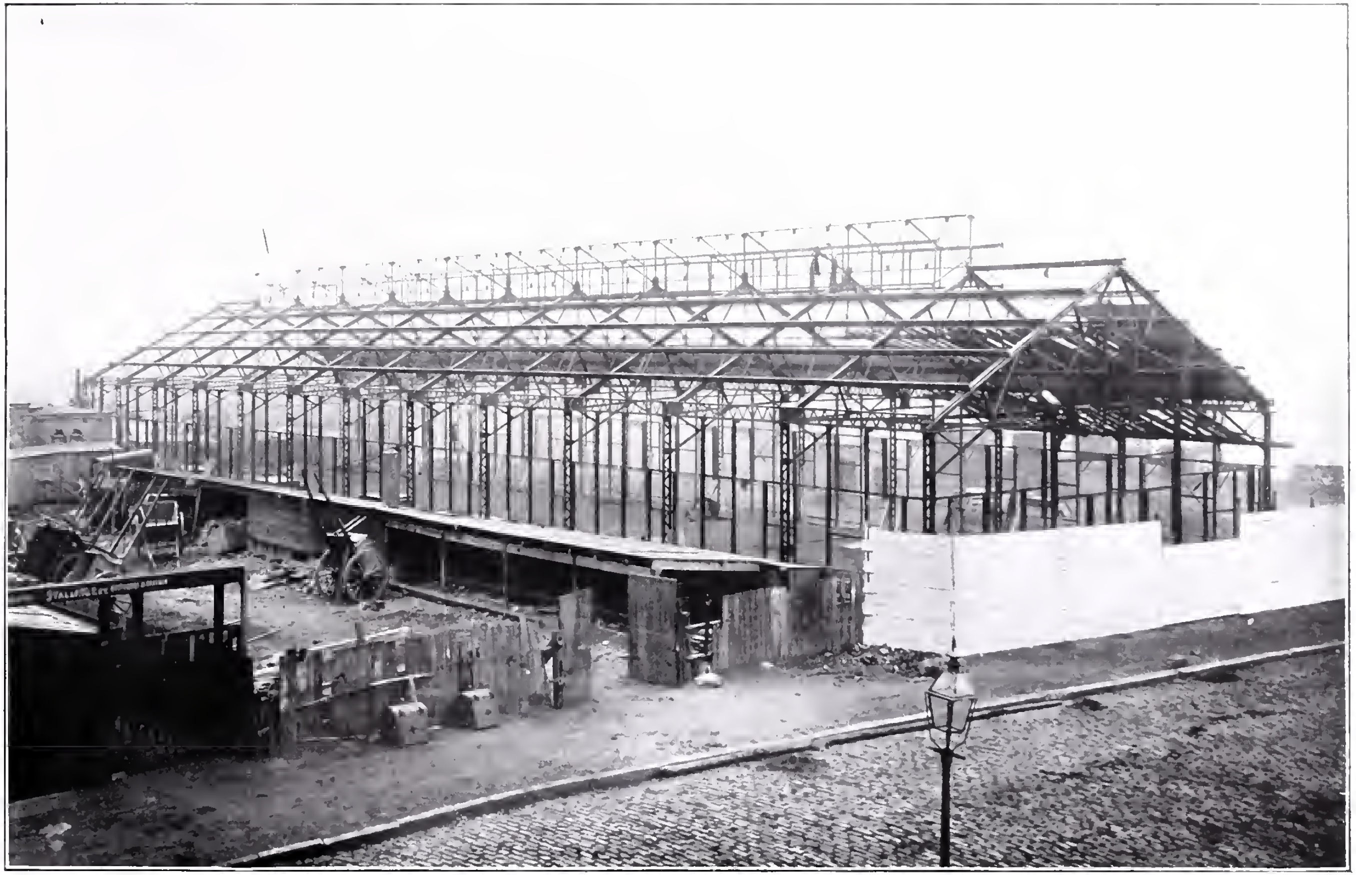
Plate No. 51.







Eastman Co., 58th Street near North River, New York City.

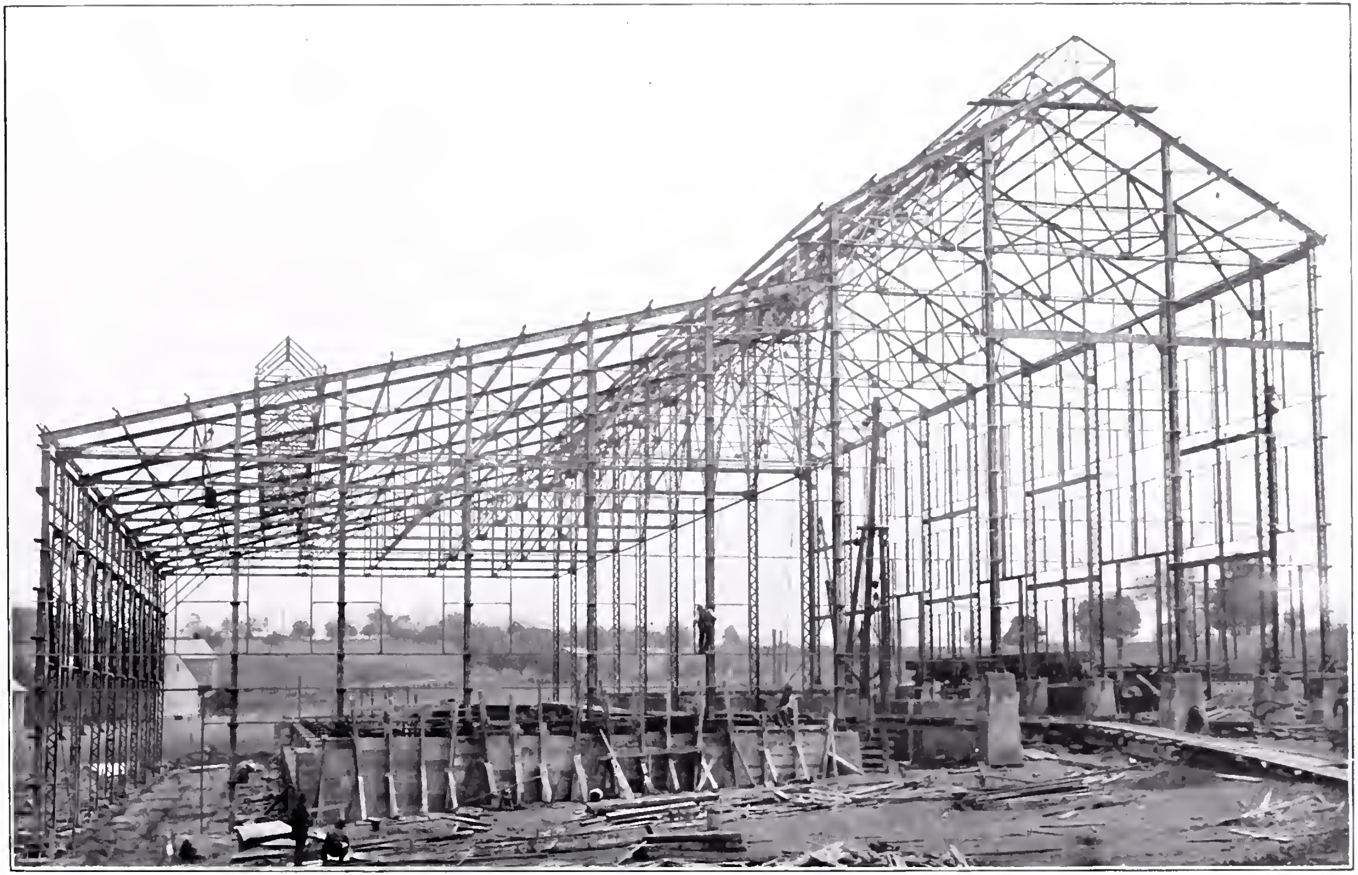


STEEL WORK DESIGNED, FURNISHED AND ERECTED BY MILLIKEN BROTHERS.

Eastman Co., 58th Street near North River, New York City.

STEEL WORK DESIGNED, FURNISHED AND ERECTED BY MILLIKEN BROTHERS.

Atlas Cement Co., Northampton, Pa.



STEEL WORK DESIGNED, FURNISHED AND ERECTED BY MILLIKEN BROTHERS.

STEEL WORK DESIGNED, FURNISHED AND ERECTED BY MILLIKEN BROTHERS.

STEEL WORK DESIGNED, FURNISHED AND ERECTED BY MILLIKEN BROTHERS.

STANDARD SPECIFICATIONS FOR SHEET METAL WORK.

Quality of material.—The iron or steel used in the manufacture of sheets is to be of "best bloom" uniformly rolled. In the case of galvanized material, care is to be taken to see that it is first carefully pickled and cleaned from all scales and acids. Sheets are then to be heavily galvanized, using good quality zinc.

NOTE.—Galvanized sheets should never be painted until after they have been exposed to the weather for several years, as the paint will not adhere. All galvanized work will be shipped unpainted.

Size of sheets, corrugations, etc.—Corrugated sheets can be furnished in 26 inch or $27\frac{1}{2}$ inch (66.038 $^c/_m$ or 69.848 $^c/_m$) widths, and in lengths not exceeding 10 feet (3.0480 meters).

Corrugated iron can be furnished in $2\frac{1}{2}$ inch or 3 inch (6.350 $^c/_m$ or 7.620 $^c/_m$) corrugations. The $2\frac{1}{2}$ inch (6.350 $^c/_m$) corrugations should be approximately $\frac{5}{8}$ inch (1.588 $^c/_m$) deep, and the 3 inch (7.620 $^c/_m$) corrugations approximately $\frac{3}{4}$ inch (1.905 $^c/_m$) deep.

For general practice, $2\frac{1}{2}$ inch (6.350 $^c/_m$) corrugations are most extensively used. The contractors have the option of deciding the exact width of sheets and width of corrugation.

Gauge and Thickness of Sheets: (U. S. Standard.)

Gauge.	Approximate thickness in inches.	Approximate thickness in centimetres.
No. 26	.01875	.047625
No. 24	.025	.0635
No. 22	.03125	.079375
No. 20	.0375	.09525
No. 18	.05	.1270

Spacing of purlins for roofs.—Roof purlins and siding girts designed to receive corrugated covering should not as a rule be spaced any further than 5 feet or 6 feet (1.5240 or 1.8288 meters) centers, and the gauge of the corrugated sheets should be proportioned to the loads to be sustained.

Application of corrugated iron.—The siding sheets can easily be taken of a lighter gauge than the roofing sheets. However, in no case shall sheets be used of less than No. 26 gauge, as sheets lower than this gauge are not serviceable.

In applying corrugated sheets for roofing purposes the sheets shall be designed or laid out so they will have an end lap of not less than 5 inches (12.70 $^c/_m$), and a side lap of not less than 1½ corrugations. The siding sheets must be arranged so as to give a minimum horizontal lap of 3 inches (7.62 $^c/_m$), and a vertical lap at sides of at least one (1) corrugation. The roofing sheets must be secured to roof purlins by means of wrought iron galvanized straps of No. 14 x ¾ inches (.19844 x 1.905 $^c/_m$) wide, spaced not over 12 inches (30.479 $^c/_m$) apart, and each strap must pass entirely around the purlins, and provided with holes so they can be riveted at both ends to corrugated sheets with tinned rivets.

The siding sheets are to be secured with single galvanized clips of ⅛ inch x ¾ inch (.317 $^c/_m$ x 1.905 $^c/_m$) metal, which, however, do not need to pass entirely around the girts. These also are to be riveted to the corrugated sheets with tinned rivets.

The roofing sheets when erected in place on the building are to be riveted together at horizontal laps at each corrugation, and the vertical seams at every 6 inches (15.240 c/m).

The siding sheets are to be riveted together at horizontal laps at every other corrugation, and at vertical seams every 6 inches (15.240 c/m). Tinned rivets are to be used throughout, and all riveting must be done at tops of corrugations and not in the valleys.

Ridge rolls.—To be formed to suit pitch of roofs, and to be of No. 24 gauge galvanized iron. When setting, the edges are to be hammered to fit into corrugations of roofing. Ridge when erected in place is to be riveted to roofing sheets with tinned rivets.

Casings, etc.—Outside casings for doors, windows, corners and baseboards to be of No. 24 gauge galvanized iron, and must be formed to required shapes and sections, and secured to corrugated iron with tinned rivets, or to the wood trim, etc., with tinned nails.

Flashings, etc.—Flashings at intersections of roofs and monitors, gable ends, eaves, etc., to be of No. 24 gauge galvanized iron, formed to suit pitch, etc., and secured to corrugated iron with tinned rivets.

Gutters and Leaders.—Gutters along eaves can be made of either half round section or moulded, but should in no instance be made of less than No. 24 gauge galvanized iron. Gutters are to be arranged with a sufficient pitch to carry off water, and bent to true form and section.

Leaders are to be made of corrugated section, not less than No. 24 gauge galvanized iron. The size of gutters and leaders is determined by roof surface and the quantity of water they are to carry off.

Valley gutters are to be made of No. 24 gauge galvanized iron and are to be supported on corrugated sheets, which in turn are supported on bar straps secured to purlins. Gutters and straps are to be formed to give correct pitch, shape, etc.

Louvres.—Louvres for monitors are to be made of No. 24 gauge galvanized iron, bent to shape so as to prevent water from driving in, and are to be supported by angles and bar frames, bent to true forms, this method of construction being used where louvres are continuous.

Louvres used in connection with wood sash in monitors are to be arranged with wood core frames, the slats being set in between, presenting a finished appearance in connection with window casing. Louvres not otherwise specified are made stationary, but in special cases can be made movable and operated with chains or gearing.

Skylights.—Skylights are to have bars formed for the support of glass, made of No. 24 gauge galvanized iron, with iron core bar, the size of same depending upon the span; these skylight bars to be provided with condensation gutters and capping pieces. Cross bars to be furnished at joints.

In connection with the skylights, flashing must be provided at sides, top and bottom. Glass for skylights should not be less than $^3/_{16}$ inch (.476 $^c/_m$) ribbed, and can be furnished in $^1/_4$ inch or $^3/_8$ inch (.635 $^c/_m$ or .953 $^c/_m$). An excess of 10% of glass will be furnished over actual amount required.

Ventilators.—In case building is designed without monitors, and ventilation is desired, this can be accomplished by circular ventilators from 12 inch (30.479 $^c/_m$) diameter, upwards, so designed as to promote circulation of air and at the same time prevent water from getting into the building.

Wood backing.—At corners and bases of buildings, etc., where required to make a firm backing for the casings, rough spruce joists and boarding will be provided, with the nails, screws, etc., required for setting. The necessary holes in iron framework will also be provided.

Marking, and Erection Drawings.—All individual pieces are to have distinguishing marks to agree with corresponding marks on our drawings, and as we furnish "erection drawings" for our work, this will facilitate the erection and avoid the possibility of mistakes.

Boxing.—All sheet metal sections are "nested" and carefully crated.
Crates are secured at corners with band iron.
All rivets, bolts and small pieces are boxed.
Glass is boxed separately.

STANDARD SPECIFICATIONS FOR WINDOWS, DOORS, SHUTTERS, ETC.

WOOD WINDOWS.

Stationary windows.—Have sashes fixed in frame with stop beads, no inside trim.

Pivoted windows.—Have sashes arranged to swing on pivots, placed centrally, either on the sides so sashes will swing on horizontal axis or on the top so sashes will swing on vertical axis. Sashes will be provided with division bars for glass. Windows will be provided with jamb, head and sill, outside casing and stop beads for sashes. No inside casing will be provided (excepting when specified). Cords, catches, hooks, etc., for operating sashes will be provided.

Hinged windows.—These have sashes hinged along top, bottom or sides, to suit conditions, and in general detail are similar to pivoted windows.

Double hung windows.—These have two sashes which move up and down in parallel grooves in the frame. The sashes are balanced by means of cord and pulleys attached to iron counter-weights moving inside the frame which is of box shape. Sashes will be provided with division bars for glass. Windows

will be provided with box side frames, head, sill and stop beads. Cords, weights, pulleys and hardware will be provided.

Special operating device.—In the case of continuous lines of windows in roof monitors, or where sashes are placed so they cannot be readily reached, "worm gear" or other special operating device will be provided where specified, so that sashes may be operated from floor.

General.—Sashes and frames are made of white pine wood. Sashes only will be primed.

For shipment, sashes will be assembled and several packed in one crate. Frames for sashes will be "knocked down", that is, taken apart and then crated.

In connection with windows, we will furnish all the rough lumber for blocking, as well as necessary screws, washers and nails required for assembling and setting.

Glass, putty, etc.—When glass is required for sashes we will furnish good quality, single thick, clear American glass (unless a different kind is specified), with an excess of 10%. Glass will be cut to exact size.

With glass we will also furnish the points required for glazing, as well as a sufficient quantity of "Glazier's Linseed Oil Putty."

All material will be carefully boxed.

IRON WINDOWS.

For certain classes of buildings it is desirable to have iron windows on account of their greater strength, durability and fire-proof qualities. These can be furnished in wrought iron, or of cast iron re-enforced with wrought iron, depending upon the sizes, general lay-out, etc.

Cast or wrought iron windows are provided with frames and sills and are made with vertical or

horizontal pivoted sashes, either for the whole opening or in sections. Sashes can also be hinged on the sides or top; all arranged as may best suit conditions.

Pivots, hooks, locks, and operating devices for sashes are always furnished.

Cast or wrought iron double hung windows are never used.

Sashes are made with bars to suit glass divisions and are provided with holes and pins for securing glass.

All iron work will be painted one coat of metallic paint.

DOORS.

Doors are of various kinds.—(a) Hinged panel wooden doors, about 3 feet, 0 inches (.9144 meters) wide, 7 feet, 0 inches (2.1336 meters) high, are ordinarily provided for entrance doors, or if a wider entrance is desired, double doors about 5 feet 0 inches (1.5240 meters) total width x 7 feet 0 inches (2.1336 meters) high are furnished.

(b) Sheet metal covered doors are excellent for fire resisting purposes. These doors are made with a wood core, covered entirely with galvanized sheet iron. These doors are usually furnished in the same size as wooden doors.

(c) Sheet iron doors are in common use. They are made of crimped iron, on a bar or angle frame, the doors being hung on wrought iron strap hinges, or they can be arranged to slide on overhead track if so desired.

(d) Large storehouse or factory doors, of sizes from 6 feet 0 inches (1.8288 meters) wide x 8 feet 0 inches (2.4384 meters) high, up to 20 feet 0 inches (6.0959 meters) wide x 20 feet 0 inches (6.0959 meters) high, are commonly made of tongue and grooved sheathing on heavy wooden frame, covered on the outside

with flat galvanized iron to resist fire, if desired. These doors can be made to hinge in two folds, to slide on overhead track, or to slide vertically by means of counterbalance weights. Or they can be made of angle framework covered on outside with crimped or corrugated iron. In connection with "swing doors" we furnish jambs, head, hinges, locks and saddles, and for "sliding doors" the tracks, hangers, sheaves, latches, etc., complete.

Corrugated Steel Rolling Shutters.—These can be furnished for small windows or doorway openings, but are more frequently used in place of the large storehouse and factory doors heretofore described. These are more convenient, and when rolled up do not interfere with anything, leaving a perfectly clear opening.

For very large openings, shutters are constructed with a center post for stiffening, which is arranged so it can be very easily removed. All shutters are made "Spring rolling" so they can be operated by hand, no winch or gear being required. Shutters are furnished with shafting, brackets, guides and fittings complete, and are given one coat of paint.

Folding Shutters.—In cases where no sashes are required, outside hinged shutters are sometimes furnished. These can be made of plain wood or metal covered. These shutters are also made of crimped iron on bar frames. Shutters are provided with locking device and rods for holding them open.

Guards.—In buildings where no sashes are required and it is not desired to close openings, wrought iron bar guards or wire mesh guards can be provided, thereby protecting openings and at the same time permitting ventilation.

Marking.—"The marking to be done in accordance with the standard practice adopted by the Contractor."

SMOKE STACKS.

It has been found that, owing to the low price of steel, it is considerably cheaper to build smoke stacks of any considerable height or diameter, in steel. In addition to this they can be furnished and put up much more quickly than brick and stone chimneys can be built. There is hardly any limit to the height and diameter to which these stacks can be made and yet be self-supporting. The only requirement is that the foundations must be ample to prevent the stack being overturned in a wind storm. These stacks are usually constructed as shown on plate No. 53.

In order to gain access to the top, a ladder is supplied up the side. An ornamental top is also furnished to give a pleasing appearance. The bottom of the stack is securely held in place by long bolts and beams buried in the foundation. Opening is made in the mason work below the stack for the boiler flue connection, and also doors to clean out the soot and ashes which ordinarily accumulate at the bottom of a large stack.

At a point near the top we usually furnish a band on which a trolley is fastened, so that when the stack needs painting all that is necessary is to arrange a block and fall on this trolley and a man can be pulled up and down the stack, and by means of the trolley can push himself around to any point that he may desire to reach for painting purposes. This is clearly shown in illustration on page 253.

Where the bottom of the stack is a considerable distance from the boilers, it is not necessary to line the stack, as the products of combustion are sufficiently cooled to obviate corrosion; but in cases where the boilers

are near to the base of the stack, it is advisable to line the stack, in some cases with fire brick and in some cases with common brick, for at least two-thirds of the distance up the stack; but we recommend a cheaper, and what we consider a better, form of construction, that is, our patent slab construction which has already been referred to in the previous part of this catalogue. This lining has the advantage over brick in that it takes up less room; consequently the diameter of the steel stack can be less, and further, it is not porous like ordinary brick, hence the gases of combustion do not get at the steel shell.

For the convenience of our customers we give on Table No. 38 the diameter and height of stacks corresponding to the nominal English horse power for boilers; also the effective area and the actual area of stacks of different diameters, and on Table No. 39 we give the equivalent French horse power to English horse power, so that the table No. 38 may be used for the English or the metric system.

We are also prepared to furnish stacks which are not self-supporting; in other words, guyed stacks. Illustration of four of these stacks is shown on page 253.

We are also prepared to furnish very ornamental stacks. An example of this is shown in the photograph on page 252, where a circular stair is used to gain access to the balcony or platform on top, which has a very ornamental railing. The extreme top of the stack is also supplied with an ornamental railing. This class of work is usually furnished for cities where the stack is intended to be in keeping with the building.

Plate No. 53.

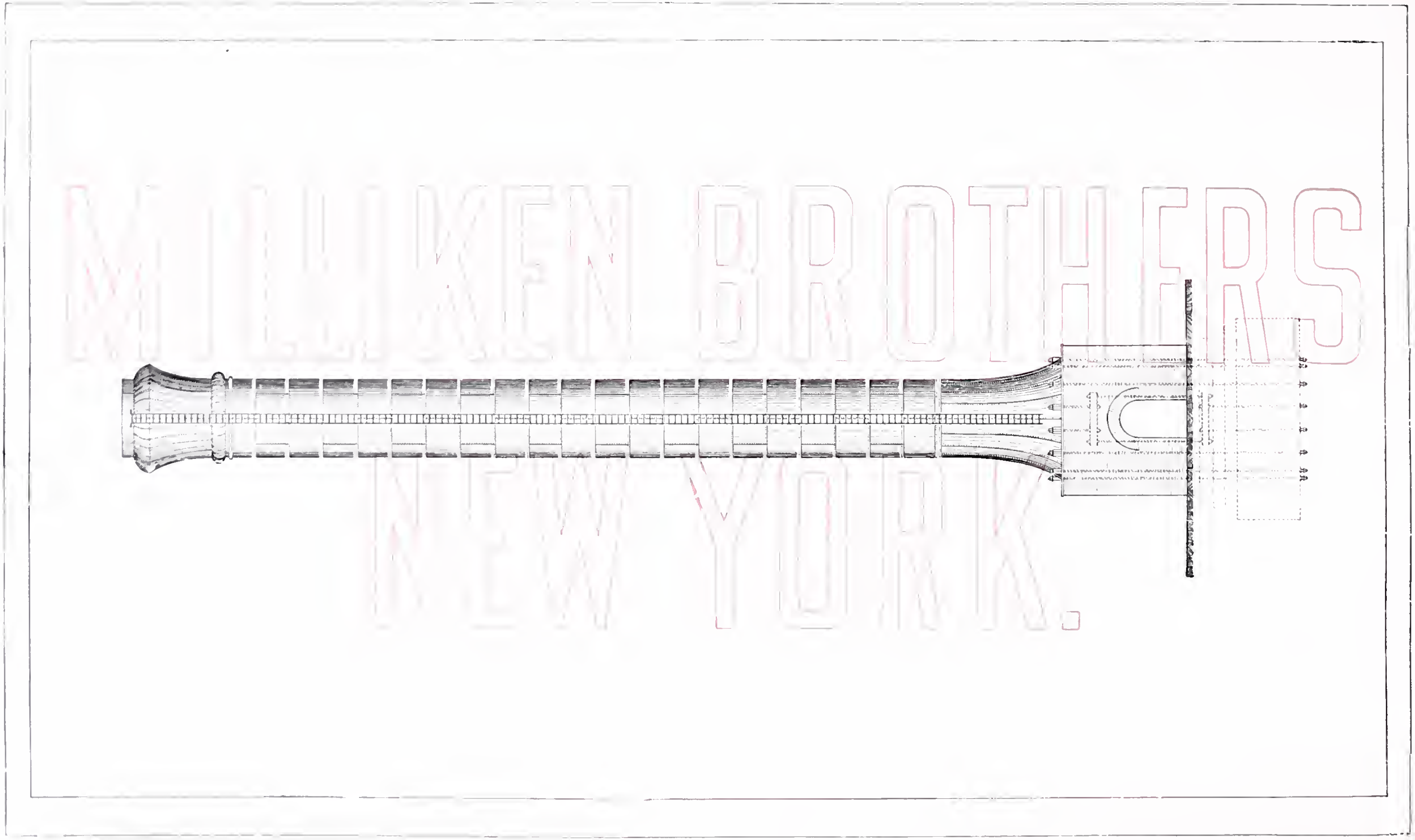


Table No. 38.

Dimensions of Chimney Stacks for Boilers of different Horse Power (English).

Inside Diam. in inches.	Inside Diam. in metres.	Height of Chimney Stack in metres and feet. 50ft. 15·2397m	60ft. 18·2876m	70ft. 21·3356m	80ft. 24·3835m	90ft. 27·4315m	100ft. 30·479m	110ft. 33·527m	125ft. 38·099m	150ft. 45·719m	175ft. 53·339m	200ft. 60·958m	225ft. 68·579m	250ft. 76·198m	275ft. 83·818m	300ft. 91·438m	Effective Area. Sq feet	Effective Area. Sq metres	Actual Area. Sq feet	Actual Area. Sq metres
		Commercial Horse Power (English).																		
18	0·4572	23	25	27													0·97	·0901	1·77	·1644
21	0·5334	35	38	41													1·47	·1365	2·41	·2238
24	0·6095	49	54	58	62												2·08	·1932	3·14	·2917
27	0·6857	65	72	78	83												2·78	·2582	3·98	·3697
30	0·7619	84	92	100	107	113											3·58	·3325	4·91	·4561
33	0·8381		115	125	133	141											4·47	·4152	5·94	·5518
36	0·9143		141	152	163	173	182										5·47	·5081	7·07	·6568
39	0·9905			183	196	208	219										6·57	·6103	8·30	·7710
42	1·0667			216	231	245	258	271									7·76	·7209	9·62	·8937
48	1·2191				311	330	348	365	389								10·44	·9698	12·57	1·167
54	1·3715				402	427	449	472	503	551							13·51	1·255	15·90	1·477
60	1·5239				505	539	565	593	632	692	748						16·98	1·577	19·64	1·824
66	1·6763					658	694	728	776	849	918	981					20·83	1·935	23·76	2·207
72	1·8287					792	835	876	934	1023	1105	1181					25·08	2·329	28·27	2·626
78	1·9811						995	1038	1107	1212	1310	1400					29·73	2·761	33·18	3·082
84	2·1335						1163	1214	1294	1418	1531	1637					34·76	3·228	38·46	3·574
90	2·2859						1344	1415	1496	1639	1770	1893					40·19	3·733	44·18	4·104
96	2·4383						1532	1616	1720	1876	2027	2167					46·01	4·274	50·27	4·670
102	2·5907						1739	1823	1944	2129	2300	2459					52·21	4·851	56·74	5·271
108	2·7431						1959	2054	2190	2399	2591	2770					58·82	5·465	63·61	5·909
114	2·8955						2192	2299	2451	2685	2900	3100					65·83	6·116	70·88	6·585
120	3·0479						2438	2557	2725	2986	3225	3448	3657				73·11	6·802	78·54	7·295
126	3·2003						2697	2829	3015	3303	3568	3814	4046				81·	7·526	86·59	8·044
132	3·3527						2969	3114	3320	3637	3928	4199	4454				89·17	8·285	95·03	8·828
138	3·5051						3255	3413	3639	3986	4306	4603	4882				97·64	9·081	103·86	9·648
144	3·6575						3553	3727	3973	4352	4701	5025	5330	5618			106·7	9·914	113·09	10·506
150	3·8099						3865	4053	4321	4733	5113	5466	5797	6110			116·06	10·783	122·71	11·393
156	3·9623						4189	4394	4684	5131	5542	5925	6284	6624	6946		126·80	11·688	132·73	12·330
162	4·1147						4527	4748	5061	5544	5988	6402	6790	7157	7505		135·9	12·629	143·13	13·296
168	4·2671						4879	5117	5454	5975	6454	6900	7318	7713	8089	8450	146·51	13·611	153·93	14·302
174	4·4195						5242	5497	5860	6420	6934	7413	7863	8287	8691	9079	15[illegible]·40	14·624	165·13	15·340
180	4·5719						5619	5893	6282	6881	7433	7946	8428	8883	9317	9[illegible]32	166·72	15·675	176·71	16·4[illegible]6

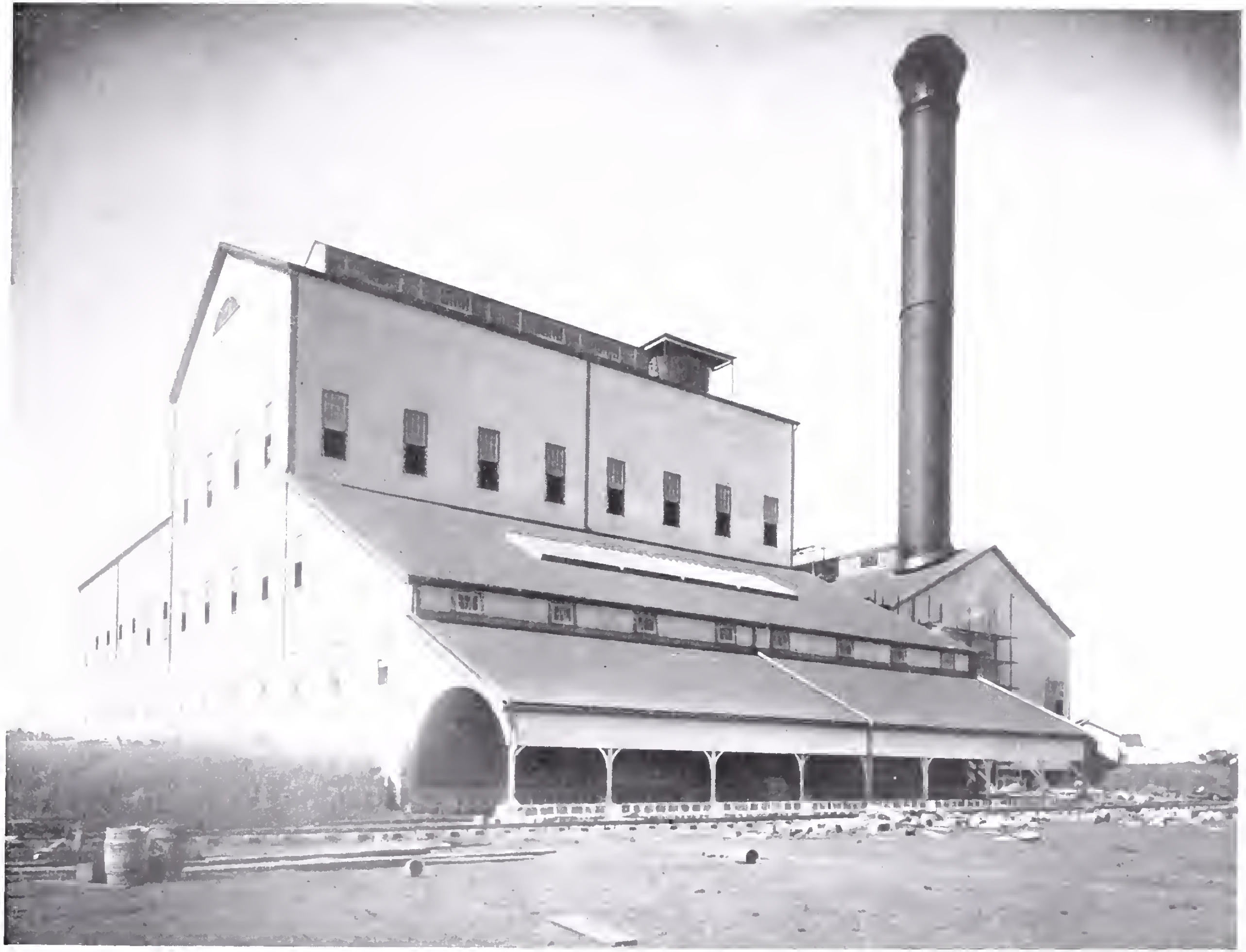
Table No. 39.

Table of English Horse Power equivalent to French Horse Power.

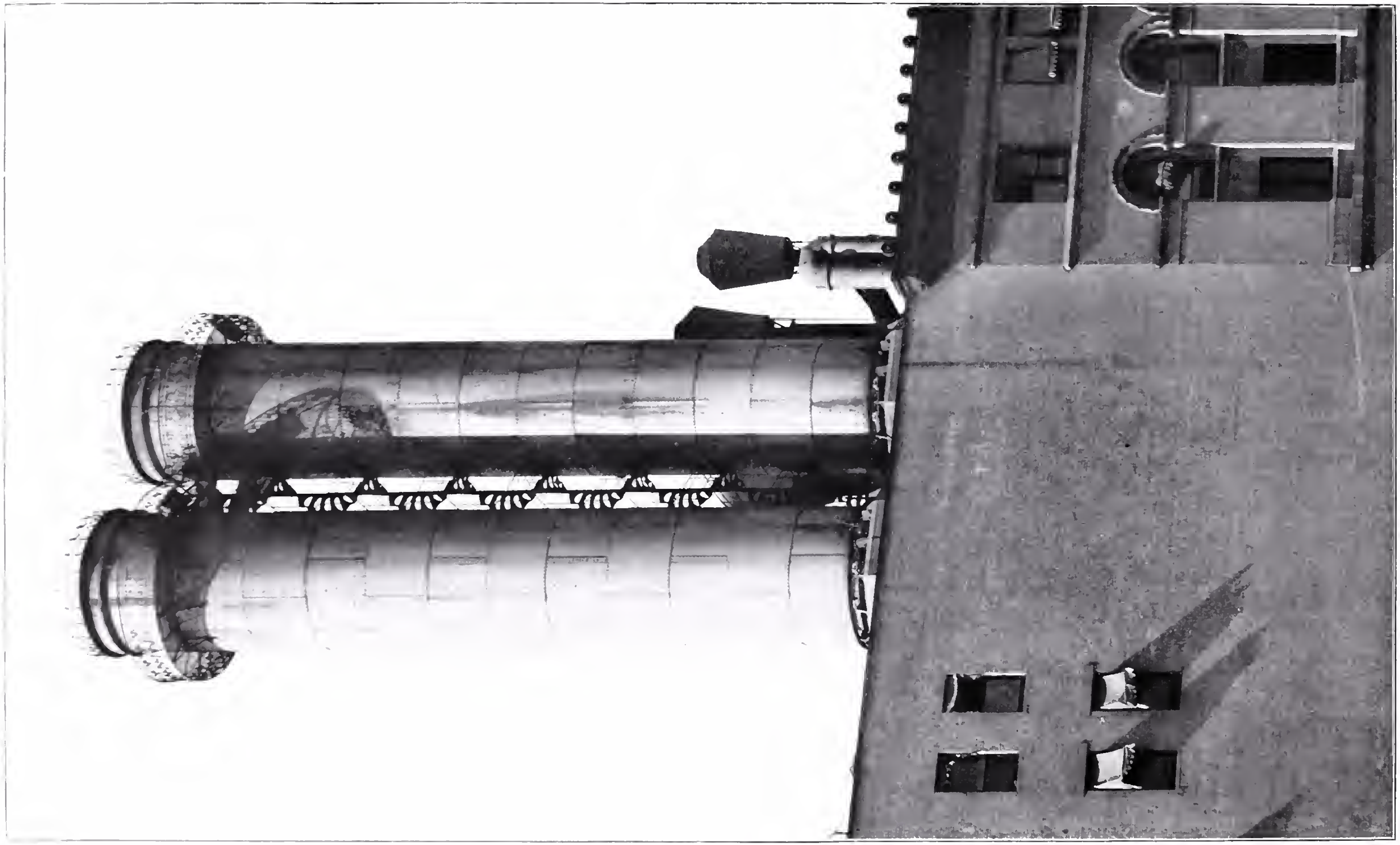
French Horse Power	0	1	2	3	4	5	6	7	8	9
0		·986337	197267	2 95901	3·94535	4·93168	5·91802	6 90436	7·89069	8·87703
10	9·86337	10 8497	11·8360	12·8224	13·8087	14·7951	15·7814	16·7677	17·7541	18·7404
20	19·72675	20·7131	21·6994	22·6857	23·6721	24·6584	25·6448	26·6311	27·6174	28·6038
30	29·59010	30·5764	31·5628	32·5491	33·5354	34·5218	35·5081	36·4945	37·4808	38·4671
40	39·45347	40·4398	41·4261	42·4125	43·3988	44·3852	45·3715	46·3578	47·3442	48·3305
50	49·31683	50·3032	51·2895	52·2758	53·2622	54·2485	55·2349	56·2212	57·2075	58·1938
60	59·18020	60·1665	61·1529	62·1392	53·1255	64·1119	65·0982	66·0846	67·0709	68·0572
70	69·04357	70·0299	71·0162	72·0026	72·9889	73·9753	74·9616	75·9479	76·9343	77·9206
80	78·90693	79·8933	80·8796	81·8659	82·8523	83·8386	84·8250	85·8113	86·7976	87·7840
90	88·77030	89·7566	90·7430	91·7293	92·7156	93·7020	94·6883	95·6747	96·6610	97·6473

Table of French Horse Power equivalent in English Horse Power.

English Horse Power	0	1	2	3	4	5	6	7	8	9
0		1·01385	2·02770	3·04156	4 05540	5·05925	6·08310	7 09695	8·11080	9·12465
10	10·1385	11·1524	12·1662	13·1801	14·1939	15·2078	16·2216	17·2355	18·2493	19·2632
20	20·2770	21·2909	22·3047	23·3186	24·3324	25·3463	26·3601	27·3740	28·3878	29·4017
30	30·4155	31·4294	32·4432	33·4571	34·4709	35·4848	36·4986	37·5125	38·5263	39·5402
40	40·5540	41·5679	42·5817	43·5956	44·6094	45·6233	46·6371	47·6509	48·6648	49·6787
50	50·6925	51·7064	52·7202	53·7341	54·7479	55·7618	56·7756	57·7895	58·8033	59·8172
60	60·8310	61·8449	62·8587	63·8726	64·8864	65·9003	66·9141	67·9280	68·9418	69·9557
70	70·9695	71·9834	72·9972	74·0111	75·0249	76·0388	77·0526	78·0665	79·0803	80·0942
80	81·1080	82·1219	83·1357	84·1496	85·1634	86·1773	87·1911	88·2050	89·2188	90·2327
90	91·2465	92·2604	93·2742	94·2881	95·3019	96·3158	97·3296	98·3435	99·3573	100·371



STEEL WORK DESIGNED, FURNISHED AND ERECTED BY MILLIKEN BROTHERS.



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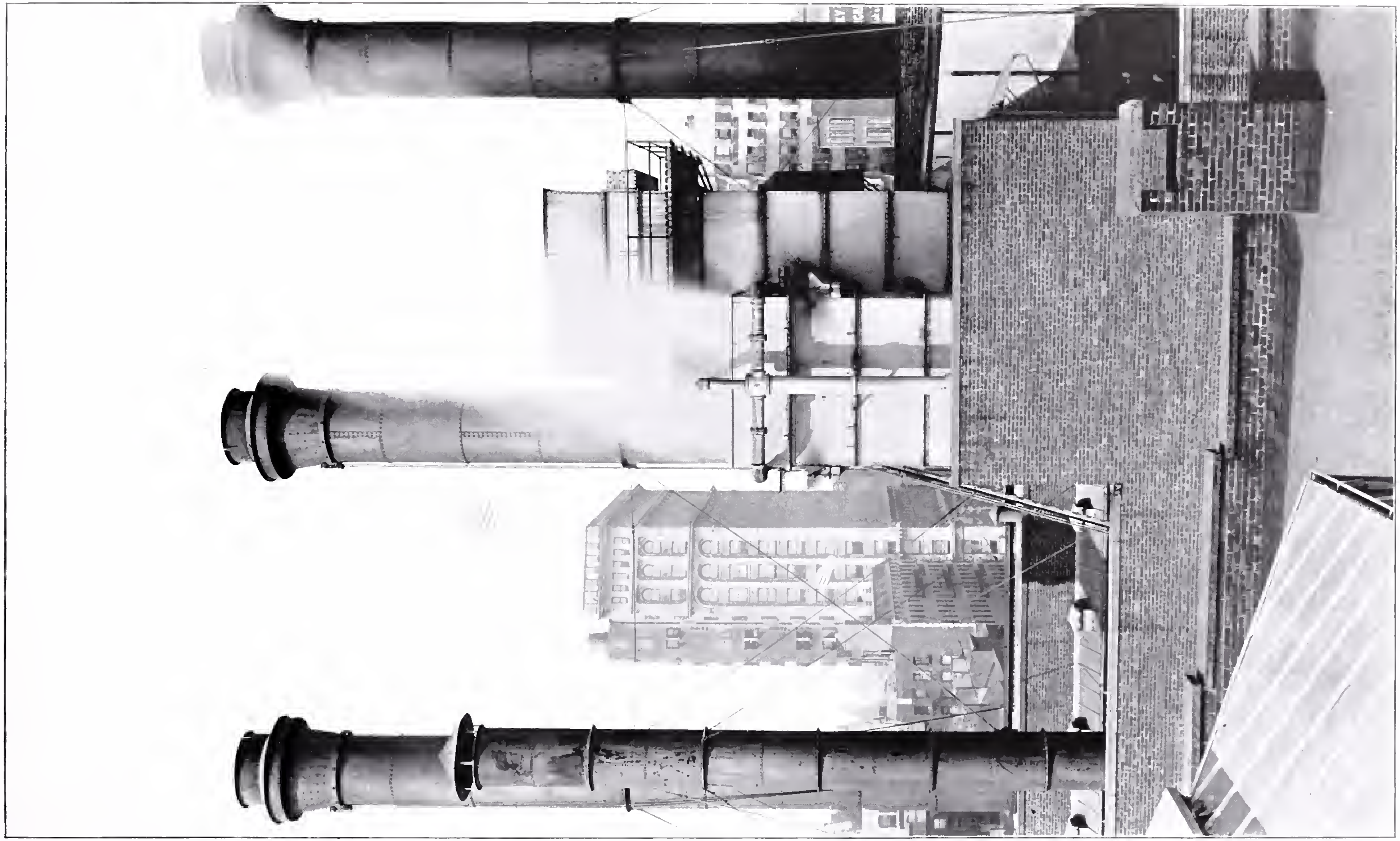

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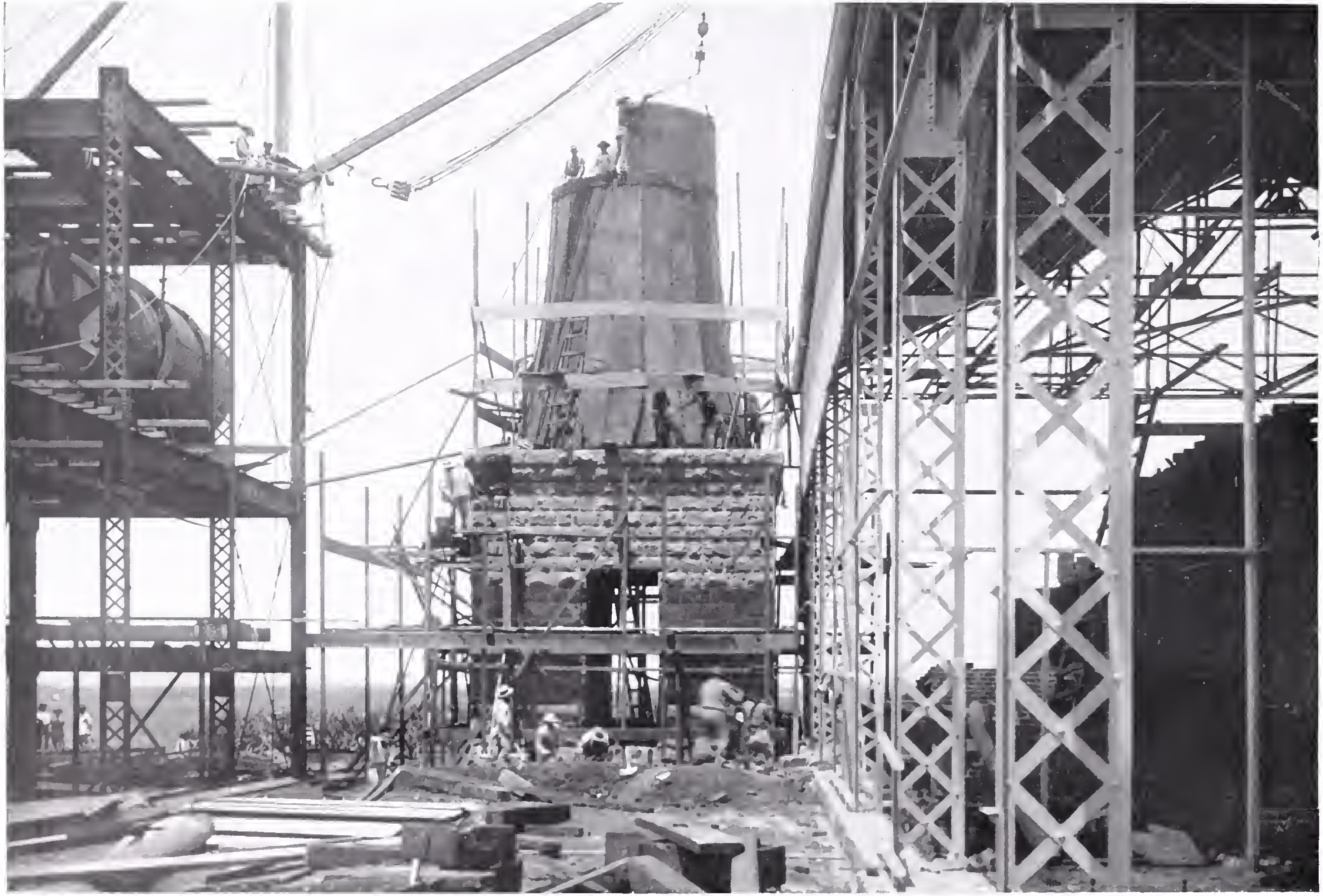

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TANKS.

In nearly every manufacturing business, for one thing or another, tanks are used for the storage of water or liquids of some kind, and they are often used for the reception and storage of rock, coal, or other classes of raw material used for manufacturing purposes. Tanks are usually round or square, as shown on Plate No. 54. In some cases the bottoms are flat, supported on wooden floors or often on steel beams. In other cases the bottoms of the tank are hopper or cone shaped in order that all of the material can be discharged from the tank and be discharged from one given point. At this point a valve is often introduced and sometimes an automatic weighing machine to carefully weigh the material that passes through the opening.

A large number of hopper shaped tanks are shown in the photograph on page 259. Platforms and stands are often required to elevate the tanks. These are fully illustrated and explained in other parts of this catalogue.

In electric light stations and large steam generating plants it is often required to store large quantities of coal. These coal bins or tanks are usually situated in the upper part of the building and the coal is discharged directly by gravity to the boilers. These bins are built of different shapes, usually with a hopper or cone shaped bottom, and their design depends largely on the size and character of the building where they are intended to go and also the number of boilers for which they are intended to supply coal. This class of work calls for special design.

We give in Tables Nos. 40 and 41 the capacity of round and square tanks in gallons and litres. This will be found very convenient for instantly getting at the capacity of any size tank of any ordinary depth.

We also make all kinds of riveted steel pipes.

Plate No. 54.

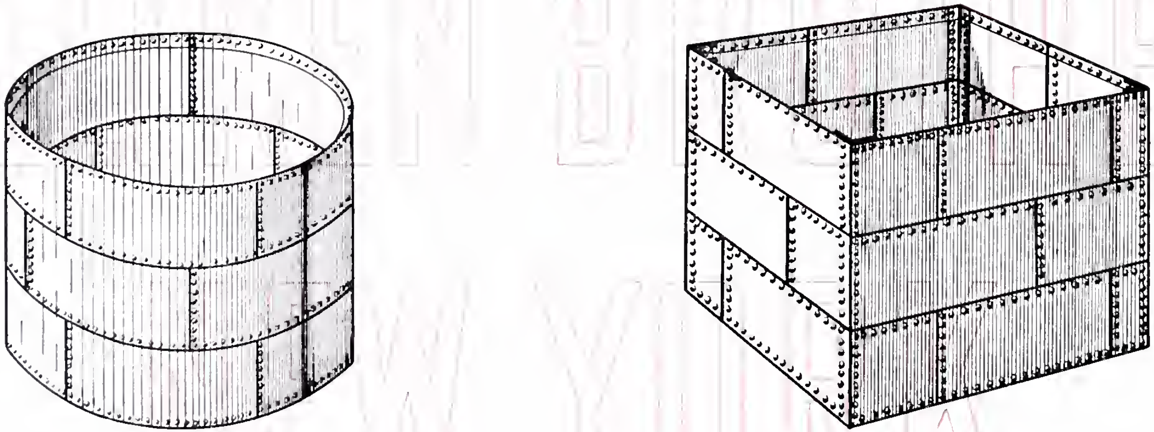


Table No. 40.

Capacity of Round Tanks in Gallons and Litres

Capacity		Inside Diameter			Inside Depth			Capacity		Inside Diameter			Inside Depth			Capacity		Inside Diameter			Inside Depth		
Gallons	Litres	Ft	In.	Metres	Ft.	In	Metres	Gallons	Litres	Ft.	In.	Metres	Ft.	In	Metres	Gallons	Litres	Ft	In	Metres	Ft	In	Metres.
158	598	3	0	.914	3	0	.914	4945	18718	10	0	3.048	8	5	2.565	14702	55650	15	6	4.724	10	6	3.200
321	1215	4	0	1.219	3	5	1.041	1943	7355	10	6	3.200	3	0	.914	17526	66339	15	6	4.724	12	6	3.810
587	2223	5	0	1.524	4	0	1.219	2590	9804	10	6	3.200	4	0	1.219	20349	77025	15	6	4.724	14	6	4.420
632	2392	6	0	1.829	3	0	.914	4155	15730	10	6	3.200	6	5	1.956	15667	59303	16	0	4.877	10	6	3.200
845	3198	6	0	1.829	4	0	1.219	6100	23090	10	6	3.200	9	5	2.870	18675	70689	16	0	4.877	12	6	3.810
1145	4334	6	0	1.829	5	5	1.651	2132	8070	11	0	3.353	3	0	.914	21683	82074	16	0	4.877	14	6	4.420
741	2805	6	6	1.981	3	0	.914	2843	10761	11	0	3.353	4	0	1.219	16660	63061	16	6	5.029	10	6	3.200
993	3759	6	6	1.981	4	0	1.219	4561	17264	11	0	3.353	6	5	1.956	19864	75181	16	6	5.029	12	6	3.810
863	3267	7	0	2.134	3	0	.914	7405	28029	11	0	3.353	10	6	3.200	23064	87304	16	6	5.029	14	6	4.420
1151	4357	7	0	2.134	4	0	1.219	2331	8823	11	6	3.505	3	0	.914	17827	67480	17	0	5.182	10	6	3.200
1847	6991	7	0	2.134	6	5	1.956	3107	11761	11	6	3.505	4	0	1.219	21233	80373	17	0	5.182	12	6	3.810
990	3747	7	6	2.286	3	0	.914	4985	18869	11	6	3.505	6	5	1.956	24619	93190	17	0	5.182	14	6	4.420
1322	5004	7	6	2.286	4	0	1.219	8093	30634	11	6	3.505	10	6	3.200	27733	104975	17	0	5.182	16	6	5.029
2120	8025	7	6	2.286	6	5	1.956	2538	9607	12	0	3.658	3	0	.914	18892	71512	17	6	5.334	10	6	3.200
1127	4266	8	0	2.438	3	0	.914	3384	12809	12	0	3.658	4	0	1.219	22490	85131	17	6	5.334	12	6	3.810
1500	5678	8	0	2.438	4	0	1.219	5428	20546	12	0	3.658	6	5	1.956	26088	98751	17	6	5.334	14	6	4.420
2031	7688	8	0	2.438	5	5	1.651	8802	33317	12	0	3.658	10	6	3.200	29387	111235	17	6	5.334	16	6	5.029
2781	10527	8	0	2.438	7	5	2.261	2754	10424	12	6	3.810	3	0	.914	19827	75051	18	0	5.486	10	6	3.200
1273	4819	8	6	2.591	3	0	.914	3672	13899	12	6	3.810	4	0	1.219	23475	88860	18	0	5.486	12	6	3.810
1697	6423	8	6	2.591	4	0	1.219	5890	22295	12	6	3.810	6	5	1.956	27281	103264	18	0	5.486	14	6	4.420
2299	8702	8	6	2.591	5	5	1.651	9638	36482	12	6	3.810	10	6	3.200	31087	117669	18	0	5.486	16	6	5.029
3148	11916	8	6	2.591	7	5	2.261	6370	24112	13	0	3.962	6	5	1.956	20944	79279	18	6	5.639	10	6	3.200
1425	5394	9	0	2.743	3	0	.914	10420	39442	13	0	3.962	10	6	3.200	24796	93860	18	6	5.639	12	6	3.810
1900	7192	9	0	2.743	4	0	1.219	6870	26004	13	6	4.115	6	5	1.956	32836	124295	18	6	5.639	16	6	5.029
3053	11557	9	0	2.743	6	5	1.956	11150	42205	13	6	4.115	10	6	3.200	22093	83628	19	0	5.791	10	6	3.200
4004	15157	9	0	2.743	8	5	2.565	7388	27965	14	0	4.267	6	5	1.956	30399	115070	19	0	5.791	14	6	4.420
1590	6018	9	6	2.896	3	0	.914	11995	45403	14	0	4.267	10	6	3.200	38883	147182	19	0	5.791	18	6	5.639
2120	8025	9	6	2.896	4	0	1.219	14298	54121	14	0	4.267	12	6	3.810	23271	88088	19	6	5.944	10	6	3.200
3402	12873	9	6	2.896	6	5	1.956	12866	48700	14	6	4.420	10	6	3.200	32018	121198	19	6	5.944	14	6	4.420
4992	18896	9	6	2.896	9	5	2.870	15326	58012	14	6	4.420	12	6	3.810	40954	155031	19	6	5.944	18	6	5.639
1762	6670	10	0	3.048	3	0	.914	13778	52152	15	0	4.572	10	6	3.200	24480	92664	20	0	6.096	10	6	3.200
2348	8888	10	0	3.048	4	0	1.219	16413	62126	15	0	4.572	12	6	3.810	33684	127509	20	0	6.096	14	6	4.420
3770	14270	10	0	3.048	6	5	1.956	19057	72134	15	0	4.572	14	6	4.420	43085	163102	20	0	6.096	18	6	5.639

Table No. 41.

Capacity of Square Tanks in Gallons and Litres.

Capacity		Side of Square			Inside Depth		
Gallons	Litres	Ft	In.	Metres	Ft.	In	Metres
202	765	3	0	.914	3	0	.914
419	1586	4	0	1.219	3	6	1.067
748	2831	5	0	1.524	4	0	1.219
808	3058	6	0	1.829	3	0	.914
1077	4077	6	0	1.829	4	0	1.219
1481	5606	6	0	1.829	5	6	1.676
948	3588	6	6	1.981	3	0	.914
1264	4785	6	6	1.981	4	0	1.219
1100	4164	7	0	2.134	3	0	.914
1466	5549	7	0	2.134	4	0	1.219
2382	9017	7	0	2.134	6	6	1.981
1262	4777	7	6	2.286	3	0	.914
1683	6371	7	6	2.286	4	0	1.219
2735	10352	7	6	2.286	6	6	1.981
1436	5436	8	0	2.438	3	0	.914
1915	7249	8	0	2.438	4	0	1.219
2633	9967	8	0	2.438	5	6	1.676
3590	13589	8	0	2.438	7	6	2.286
1621	6136	8	6	2.591	3	0	.914
2162	8184	8	6	2.591	4	0	1.219
2972	11250	8	6	2.591	5	6	1.676
4053	15343	8	6	2.591	7	6	2.286
1818	6855	9	0	2.743	3	0	.914
2424	9176	9	0	2.743	4	0	1.219
3938	14907	9	0	2.743	6	6	1.981
5150	19493	9	0	2.743	8	6	2.591
2025	7666	9	6	2.896	3	0	.914
2700	10220	9	6	2.896	4	0	1.219
4388	16611	9	6	2.896	6	6	1.981
6413	24275	9	6	2.896	9	6	2.896
2244	8495	10	0	3.048	3	0	.914
2992	11327	10	0	3.048	4	0	1.219
4862	18405	10	0	3.048	6	6	1.981

Capacity		Side of Square			Inside Depth		
Gallons	Litres	Ft.	In.	Metres	Ft	In	Metres
6358	24068	10	0	3.048	8	6	2.591
2474	9365	10	6	3.200	3	0	.914
3299	12486	10	6	3.200	4	0	1.219
5360	20289	10	6	3.200	6	6	1.981
7834	29654	10	6	3.200	9	6	2.896
2715	10277	11	0	3.353	3	0	.914
3620	13703	11	0	3.353	4	0	1.219
5883	22268	11	0	3.353	6	6	1.981
9503	35969	11	0	3.353	10	6	3.200
2968	11234	11	6	3.505	3	0	.914
3957	14761	11	6	3.505	4	0	1.219
6430	24340	11	6	3.505	6	6	1.981
10387	39318	11	6	3.505	10	6	3.200
3231	12230	12	0	3.658	3	0	.914
4308	16308	12	0	3.658	4	0	1.219
7001	26501	12	0	3.658	6	6	1.981
11309	42808	12	0	3.658	10	6	3.200
3506	13269	12	6	3.810	3	0	.914
4675	17697	12	6	3.810	4	0	1.219
7597	28756	12	6	3.810	6	6	1.981
12272	46453	12	6	3.810	10	6	3.200
8217	31103	13	0	3.962	6	6	1.981
13273	50242	13	0	3.962	10	6	3.200
8861	33541	13	6	4.115	6	6	1.981
14314	54182	13	6	4.115	10	6	3.200
9530	36076	14	0	4.267	6	6	1.981
15394	58270	14	0	4.267	10	6	3.200
18326	69369	14	0	4.267	12	6	3.810
16513	62509	14	6	4.420	10	6	3.200
19658	74408	14	6	4.420	12	6	3.810
17672	66893	15	0	4.572	10	6	3.200
21038	79635	15	0	4.572	12	6	3.810
24404	92376	15	0	4.572	14	6	4.420

Capacity		Side of Square			Inside Depth		
Gallons	Litres	Ft	In	Metres	Ft	In.	Metres
18870	71428	15	6	4.724	10	6	3.200
22463	85028	15	6	4.724	12	6	3.810
26057	98634	15	6	4.724	14	6	4.420
20106	76104	16	0	4.877	10	6	3.200
23936	90605	16	0	4.877	12	6	3.810
27766	105100	16	0	4.877	14	6	4.420
21383	80941	16	6	5.029	10	6	3.200
25455	96352	16	6	5.029	12	6	3.810
29528	111770	16	6	5.029	14	6	4.420
22698	85918	17	0	5.182	10	6	3.200
27022	102283	17	0	5.182	12	6	3.810
31345	118646	17	0	5.182	14	6	4.420
35668	135028	17	0	5.182	16	6	5.029
24053	91048	17	6	5.334	10	6	3.200
28634	108390	17	6	5.334	12	6	3.810
33216	125730	17	6	5.334	14	6	4.420
37797	143068	17	6	5.334	16	6	5.029
25447	96321	18	0	5.486	10	6	3.200
30294	114668	18	0	5.486	12	6	3.810
35141	133015	18	0	5.486	14	6	4.420
39988	151361	18	0	5.486	16	6	5.029
26880	101749	18	6	5.639	10	6	3.200
32000	121130	18	6	5.639	12	6	3.810
42240	159886	18	6	5.639	16	6	5.029
28353	107326	19	0	5.791	10	6	3.200
39154	148213	19	0	5.791	14	6	4.420
49955	189088	19	0	5.791	18	6	5.639
29865	113044	19	6	5.994	10	6	3.200
41242	156108	19	6	5.994	14	6	4.420
52619	200308	19	6	5.994	18	6	5.639
31416	119216	20	0	6.096	10	6	3.200
43384	164217	20	0	6.096	14	6	4.420
56352	209513	20	0	6.096	18	6	5.639

STEEL WORK FURNISHED AND ERECTED BY MILLIKEN BROTHERS.

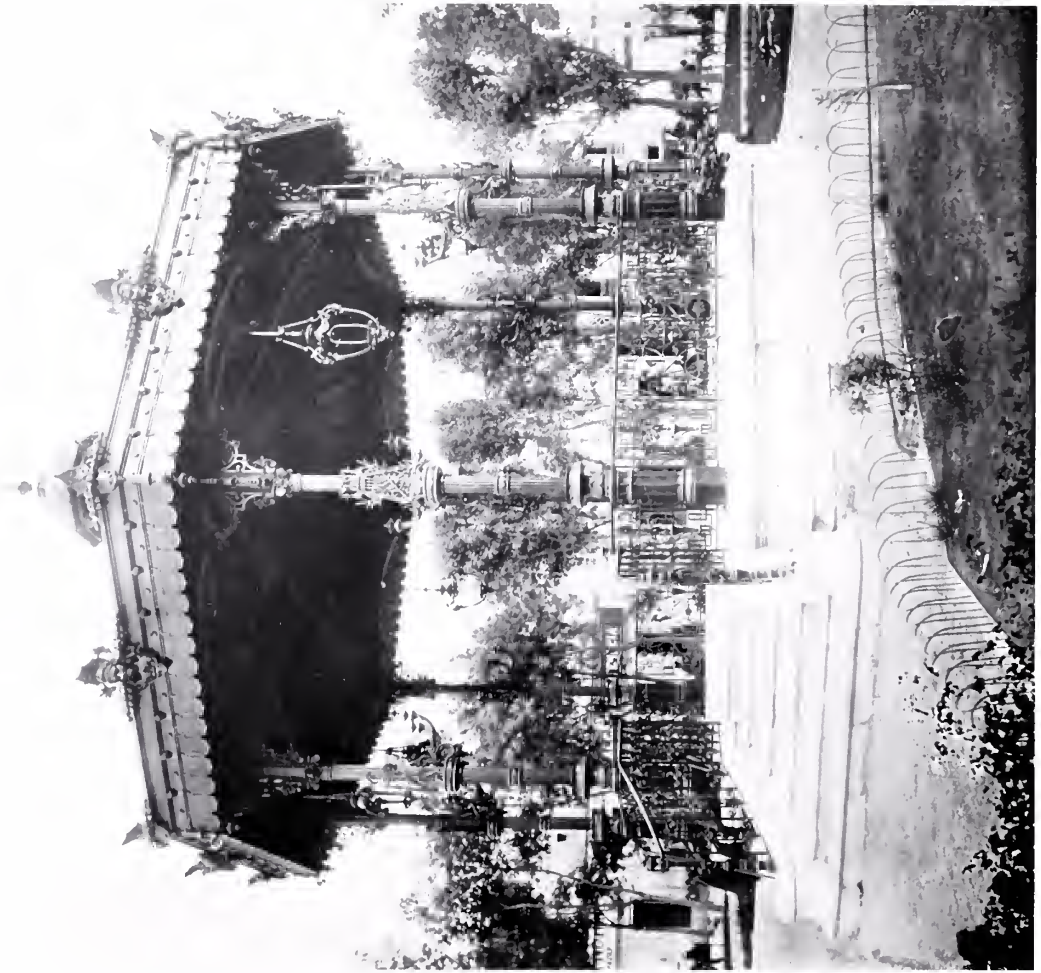
Steel work furnished and erected by Milliken Brothers.

KIOSKS, OR PUBLIC MUSIC STANDS.

In nearly all Southern countries, and in fact, in a great many of the Northern countries, it is customary to have located in the center of the principal parks, Kiosks, or Public Music Stands, where bands play at certain times. It is almost impossible to give any details relative to this class of work as it depends entirely on the size of the stand, which is largely governed by the number of men in the orchestra or band, and the detailing of the work depends entirely upon the amount of ornamentation required.

Page 262 shows a photograph of one that is rather simple and plain in design. Page 263 shows one somewhat more ornamental, and page 264 still more ornamental. When the stands are as ornamental as shown on page 262 it is desirable to have the parts which are exposed to the weather electro-bronzed, which will prevent their rusting.

Special designs will be submitted on application showing any desired amount of ornamentation.



CRANES AND DERRICKS.

On Plate No. 55 we show a very useful and inexpensive crane for the unloading of merchandise from cars or wagons, by means of a portable hoisting engine. This apparatus is so constructed that it can be easily changed from place to place, and is a handy article in storage yards, railroad stations, sugar plantations, etc.

Plate No. 56 shows a traveling crane which has not only the transverse movement of the trolley, but the entire crane moves longitudinally on an elevated steel track. A picture of one of these cranes is shown on page 272. This particular crane was arranged with two trolleys so that work could be going on at two different points at one and the same time.

We have supplied a large number of cranes of this kind for work in shops and particularly over the crushing and grinding mills in sugar cane factories. Accidents are always liable to happen to the rolls and as they are of very considerable weight it is awkward and difficult to quickly move them from their position and place new rolls in the mills. With this apparatus it is very easy for a few men in a short time to remove a roll and put a new one in position. The load is raised and lowered by a differential block, which is operated by hand chains reaching to the floor. The cross motion of the trolley is also operated by means of hand chains which run to the floor. The longitudinal motion of the entire crane on the track is controlled by two chains, one at either end of the crane which operate a longitudinal shaft, which in turn is geared to the driving wheels at either end and thus moves the crane along. It is entirely possible to have all three of the mechanical movements, that is, the hoist, the transverse motion and the longitudinal motion in operation at one and the same time.

These cranes can easily be built to span sixty feet, or even greater if necessity demands, and of course, the length of the track is unlimited. Nearly any ordinary load can be lifted, but, of course, the greater the load the slower it has to move with a given number of men. About the largest load to be lifted as a rule in sugar factories is from ten to fifteen tons.

It is necessary, on account of the transverse motion, to have the track girders securely held in position. It will be noticed that on Plate No. 56 the column supporting the track girders is shown different on the right hand side of the drawing than on the left. The left hand drawing is intended to represent a form of construction which braces the track girders and is used in places where no brace to any rigid structure can be had. The column on the right is intended to represent the form of column to be used where the track girders can be braced to some existing structure, for instance in a building. It will be noticed in the photograph on page 272 that this particular column was used, but in this case the track girders were braced sideways to the building. This prevents the structure swaying when the cross motion of the crane is used.

Plate No. 57 shows the same class of machine as Plate No. 55 only for much heavier loads and to be operated by hand. Of course steam power can easily be employed in order to get quicker motion or raise larger loads.

We also construct large derricks to be operated by either hand or steam power. Plate No. 58 shows a derrick of this kind of very large capacity. This derrick is arranged with an automatic block on the back of the mast. This block is weighted and the derrick is so rigged that the main hoisting rope will descend automatically after the load has been raised and lifted. We are in a position to make prices on derricks with a boom of almost any length and of almost any capacity. We have constructed a number of these derricks, one of which is the largest in the world and has been working most satisfactorily for a period of five or six years. This is shown in a picture on page 273. These derricks have wire guys from the top of the mast, which must be securely fastened to immovable points.

Plate No. 59 shows a derrick constructed on the same general principles as the derrick shown on Plate No. 58, except that it is intended to be used on docks or wharfs where it is impossible to run guy lines in front of the derrick; consequently the mast has to be held in position by two stiff legs securely fastened to foundations. This form of construction is specially used in Government wharfs, ship yards, etc., where boilers and engines have to be raised from vessels. A mechanical arrangement is used at the foot to revolve the derrick by power. This is also shown in this view. These derricks can also be made with any length boom and of any capacity.

Plate No. 55.

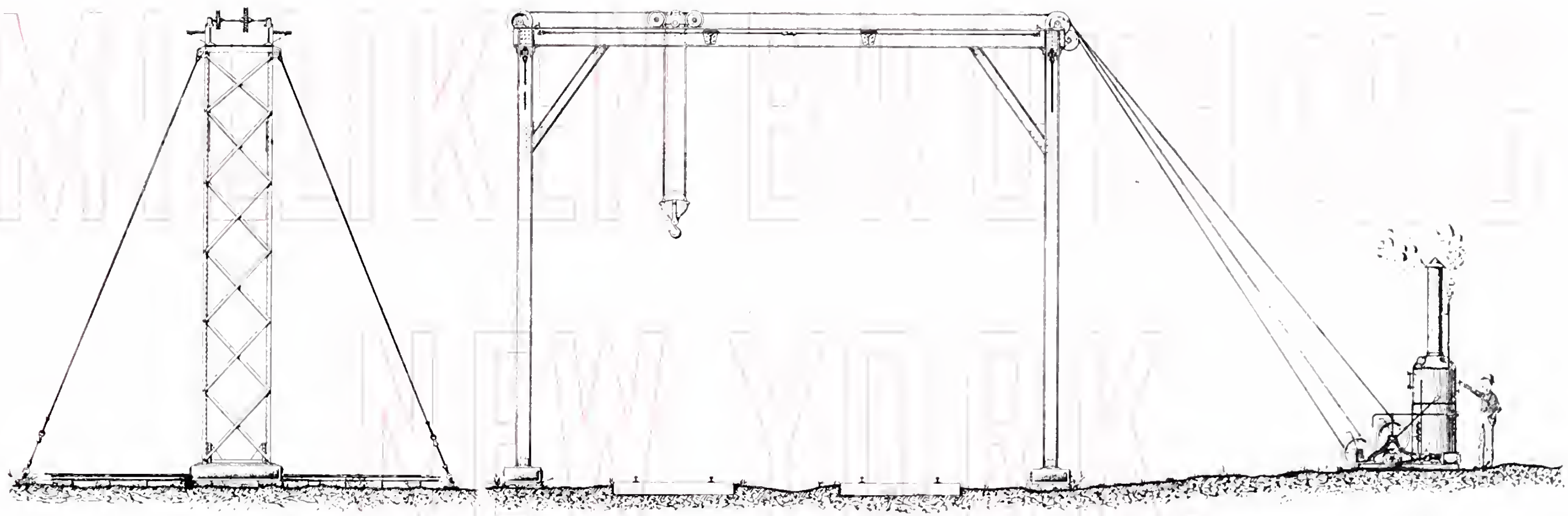
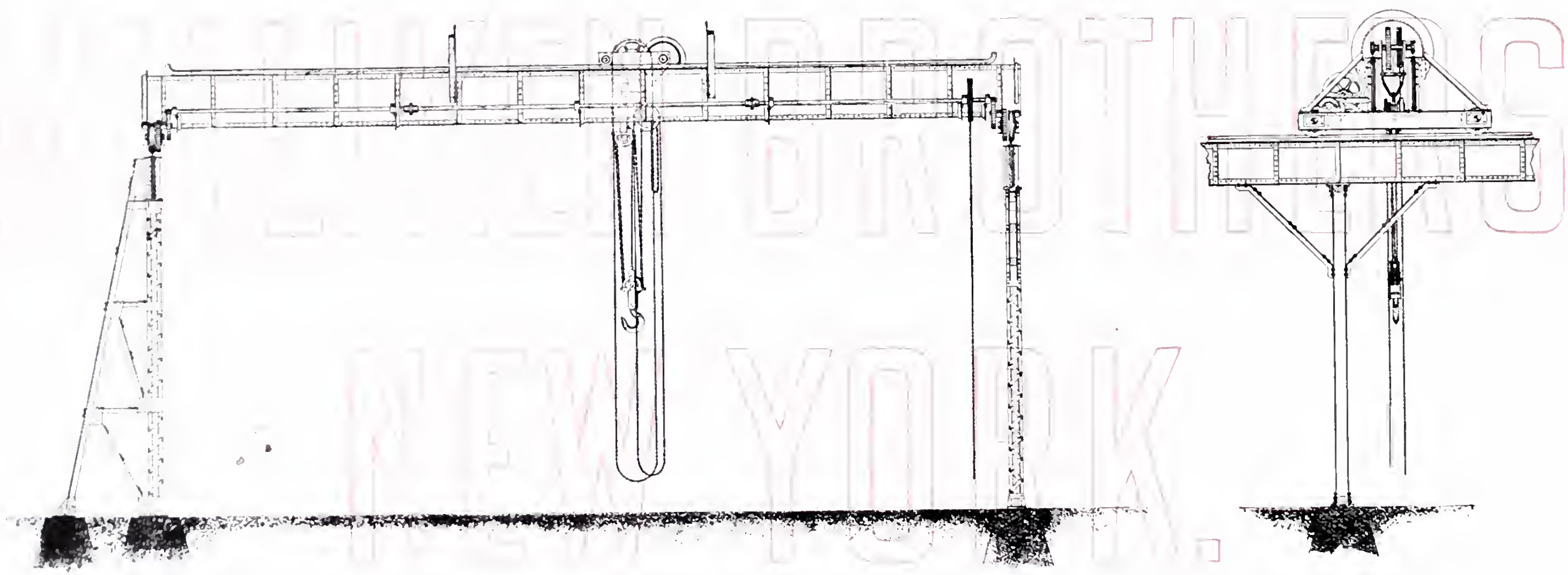


Plate No. 56.



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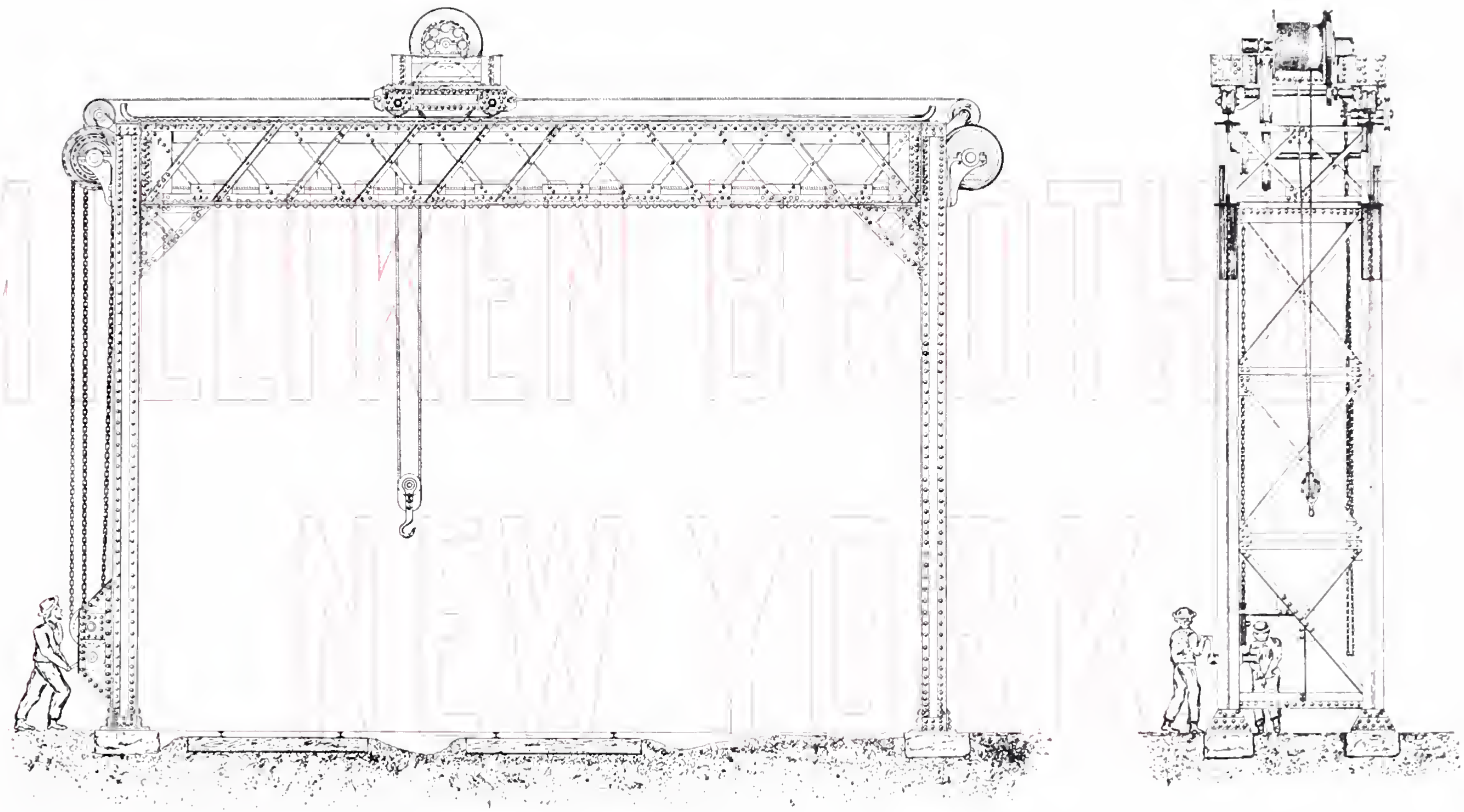


Plate No. 58.

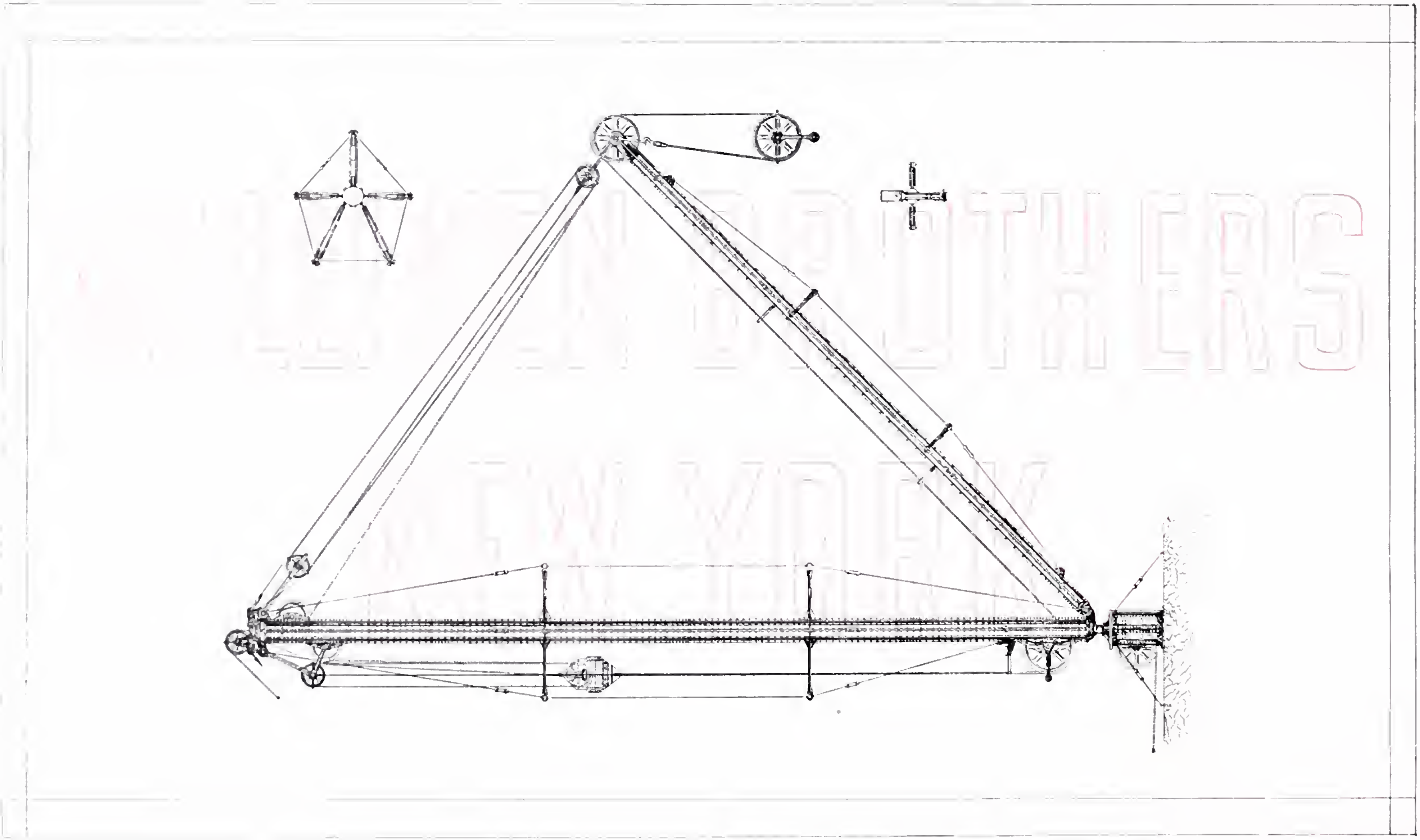
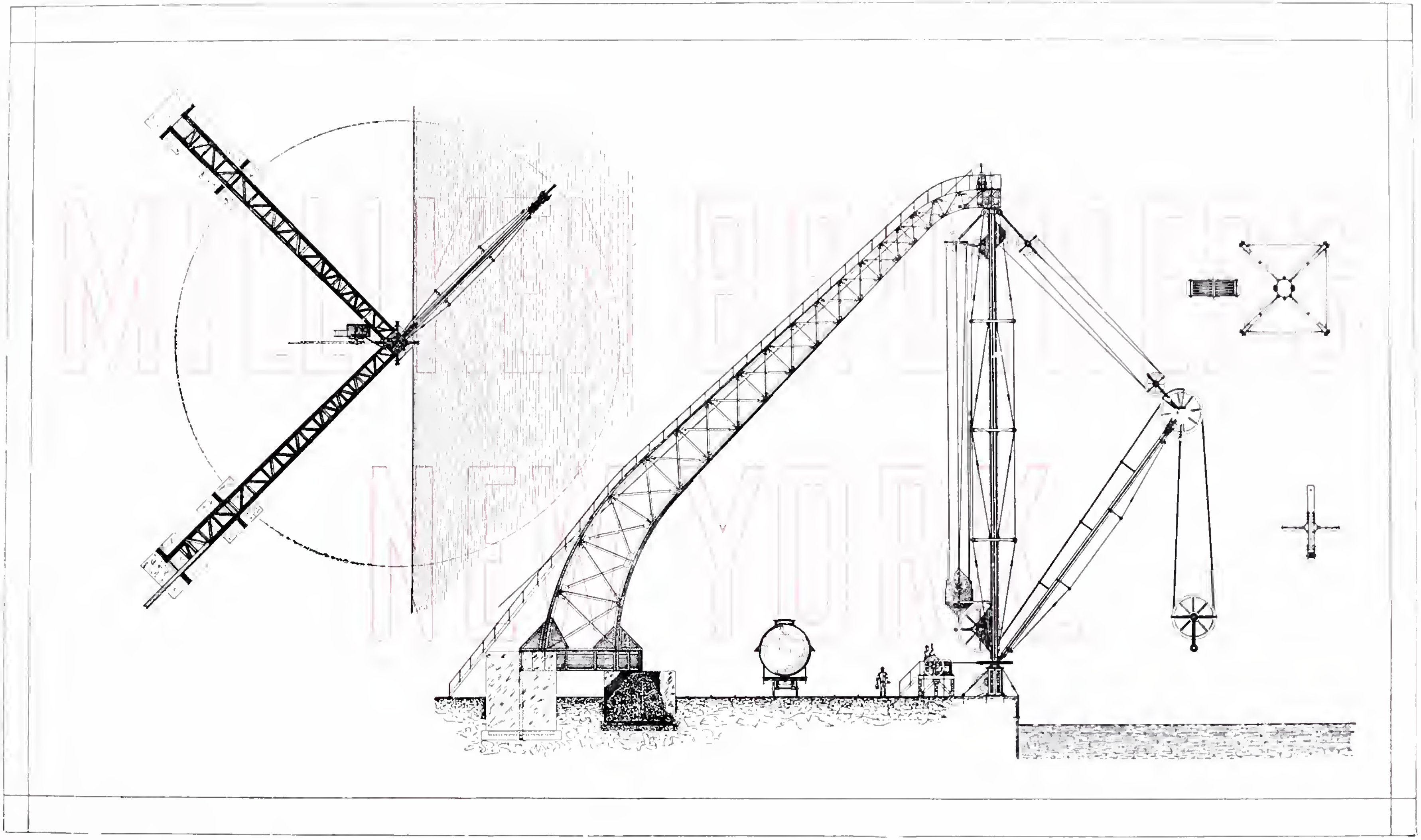
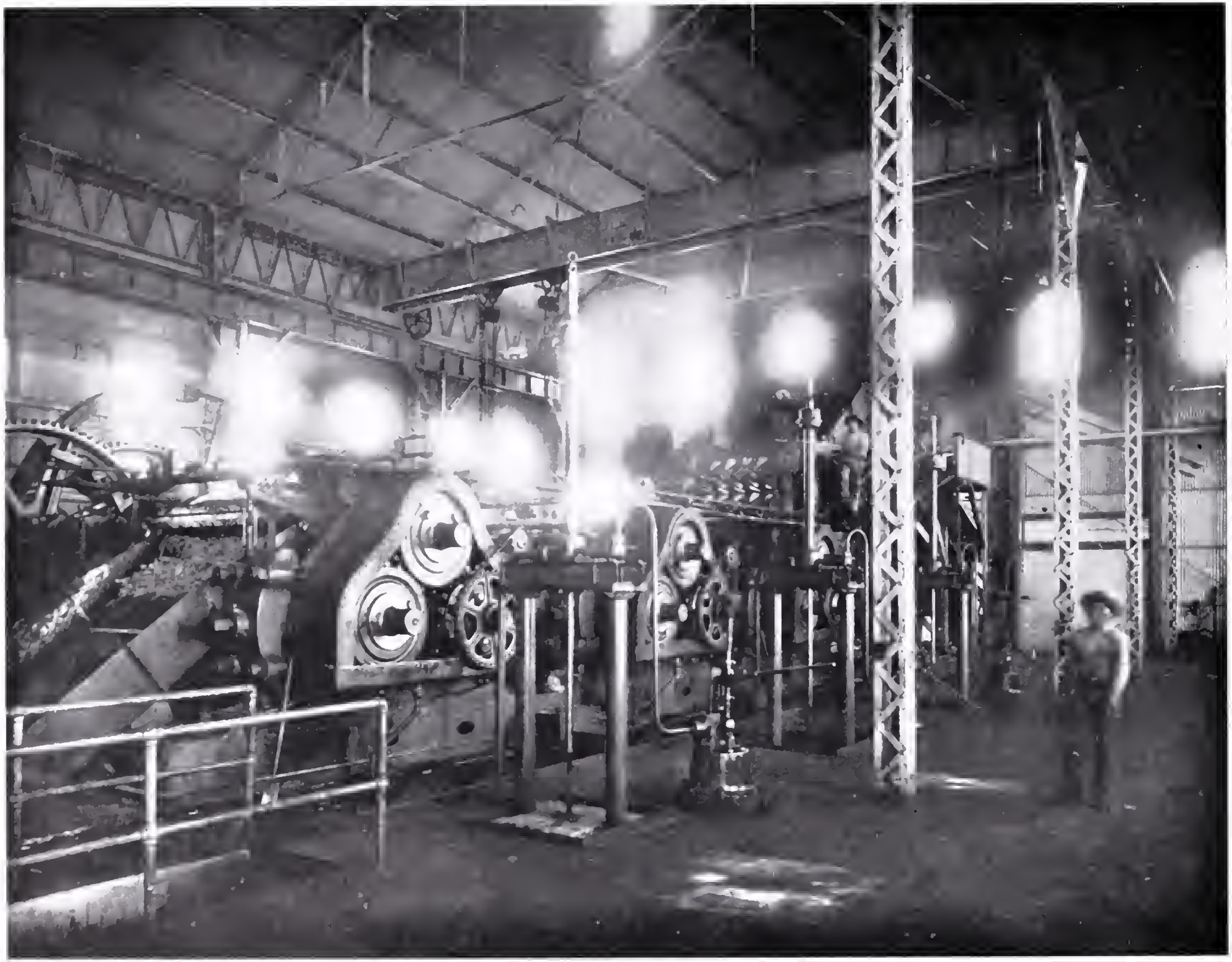


Plate No. 59.

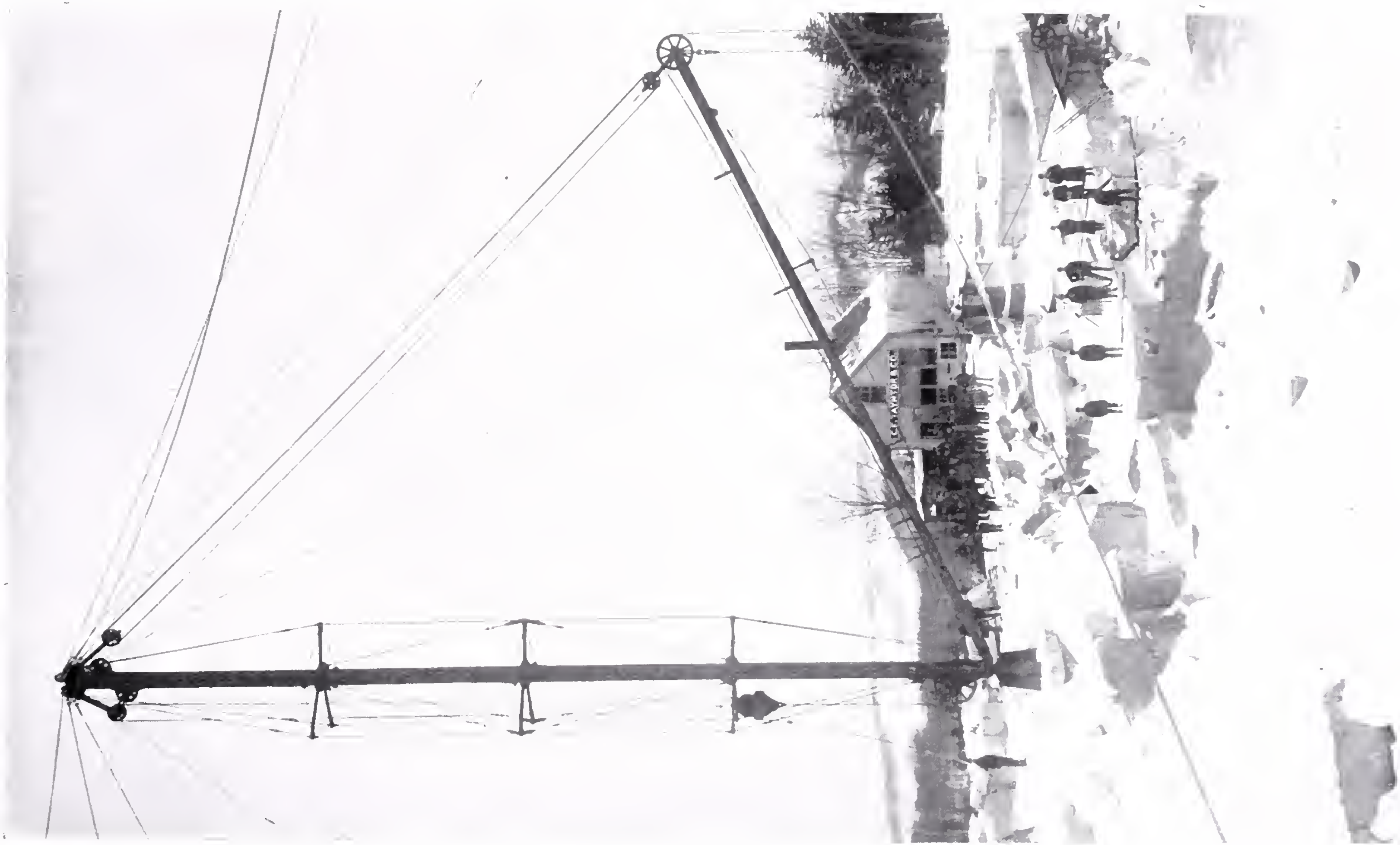


Oahu Sugar Co. Honolulu, H. I.



STEEL WORK DESIGNED, FURNISHED AND ERECTED BY MILLIKEN BROTHERS.

C. E. Tayntor & Co., Granite Quarry, Barre, Vt.



WORK DESIGNED AND FURNISHED BY MILLIKEN BROTHERS.

TANK AND BELL TOWERS.

On sugar plantations and in cities it is often advisable to have a light, ornamentally constructed tower containing a platform at the top, and a bell to be used for fire alarms. Plate No. 60 shows this class of work in detail. The platform is reached by a ladder running up the side and the top is covered with an ornamental corrugated galvanized iron roof. In cases where it is desired to protect the person on watch, the sides of the top of this tower are enclosed with glass windows, and a door for access.

Plate No. 61 shows the same general form of construction for the use of elevated tanks. It is often desirable, in order to obtain water pressure, to elevate the source of supply. This is very desirable for fire purposes. Any height can be reached and any size tank can be carried.

Plate No. 60.

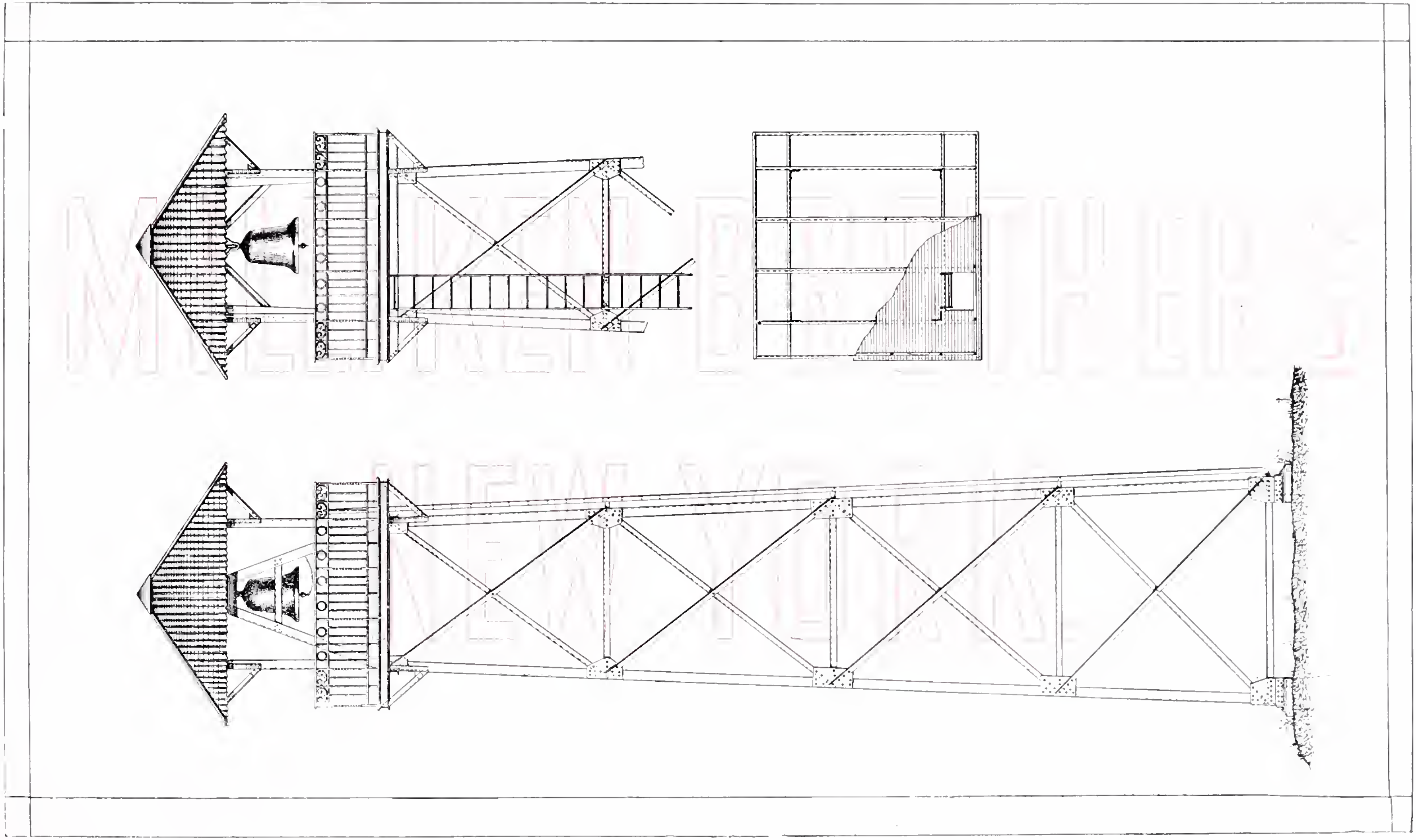
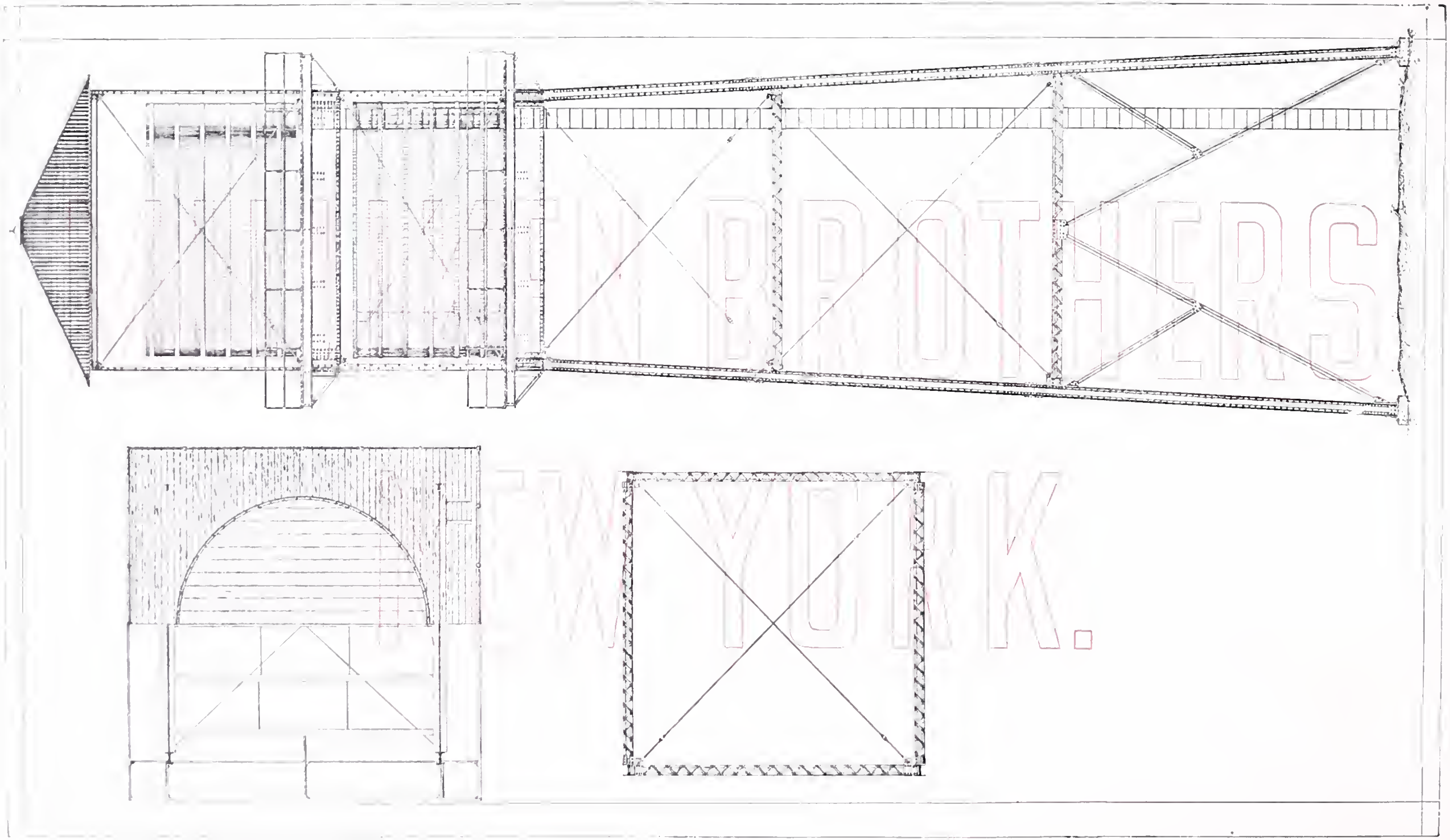
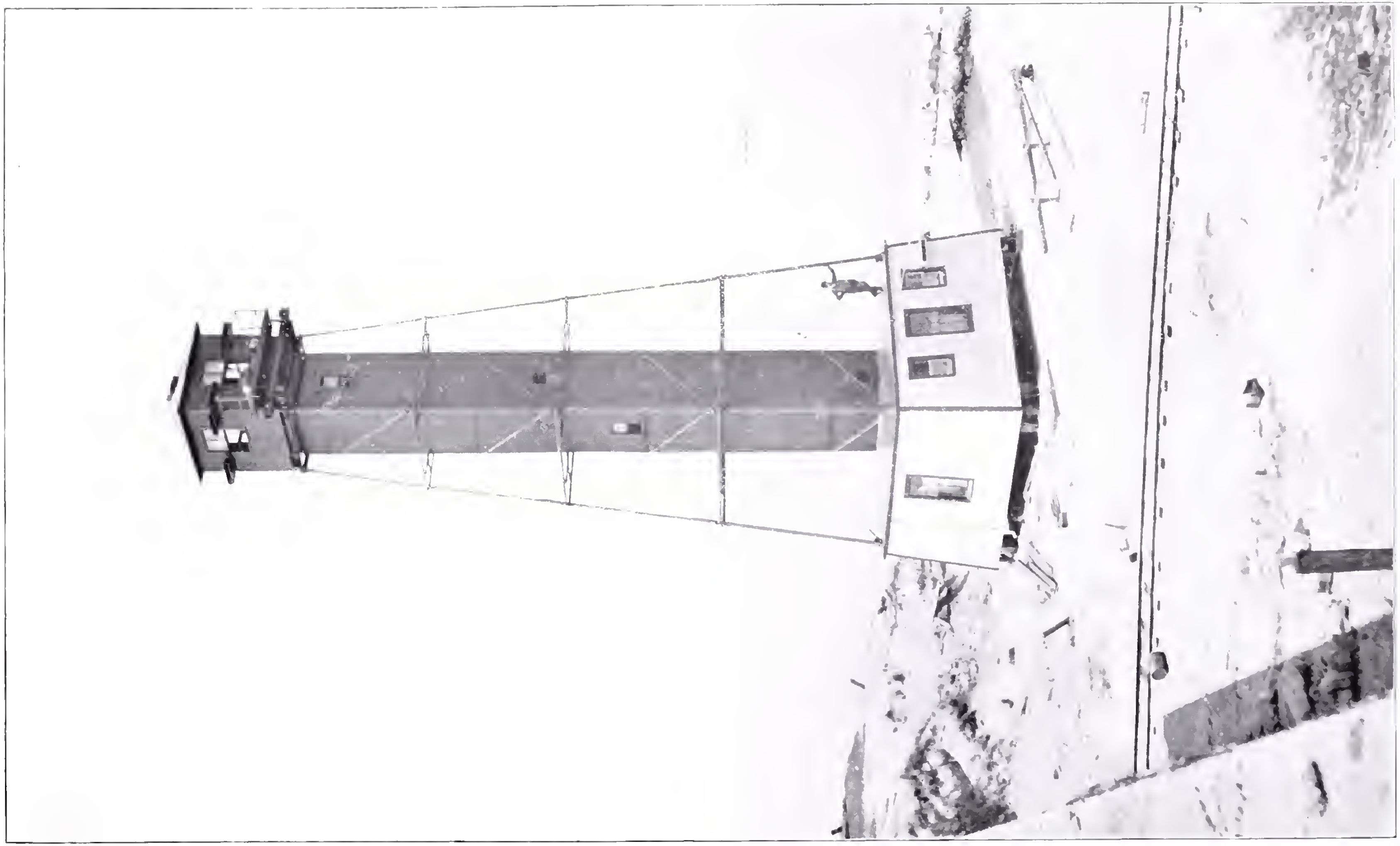


Plate No. 61.



LOOKOUT TOWER, POSTAL TELEGRAPH COMPANY, SANDY HOOK, N. J.



WORK DESIGNED, FURNISHED AND ERECTED BY MILLIKEN BROTHERS

STEEL WORK DESIGNED, FURNISHED AND ERECTED BY MILLIKEN BROTHERS.

DOCKS—PIERS.

In Southern countries where the teredo and other insects which attack wood are very active, the use of wood for piles has to be done away with and some other form of construction used. Occasionally cast iron, and in a number of instances, wrought steel columns are employed, which are sunk or driven into the sand, or in other manner anchored to the bottom. These columns are then braced by means of tie rods and struts to prevent lateral deformation, and on top of the beams connecting the columns at their top, planks are laid to form the deck of the pier. Plate No. 62 shows this construction in detail.

We find that one of the cheapest and best forms of construction to use is Phœnix columns. On the bottom of the column is fastened a screw, which has two or three holes in the same. The top of the column is closed by a plate and a stream of water under pressure is forced into the column and has its exit through the holes in the bottom of the screw. By slightly moving the column in the sand the column will gradually sink, owing to the action of the water washing the sand from beneath the bottom of the column, and the columns in this manner can be easily and securely fastened in position. Of course this method of sinking the column is only applicable where the dock or pier is built on a sandy bottom.

We are prepared to furnish estimates for supplying any proposed form of construction; also for supplying the wooden fenders, flooring, mooring posts, steps, davits, and any other apparatus required.

In order to protect goods that are liable to be stored on a pier for any length of time, it is customary to cover in the the top of the pier. This is shown on Plate No. 63. This form of construction is one universally adopted on all of the docks in New York City, and in some cases the pier is made two stories and goods are stored in the upper story, and it is also a great convenience to have passengers landed there in case of extremely large ships and vessels. The sides of the pier are battered so as to clear the sides of the vessel when making fast to the pier. The roof and sides of these piers are usually covered with corrugated galvanized sheet iron. The light is admitted through the monitor sash and through windows located at convenient points in the sides of the structure Large rolling steel shutter doors are usually used to cover the openings through which freight is moved.

Plate No. 62.

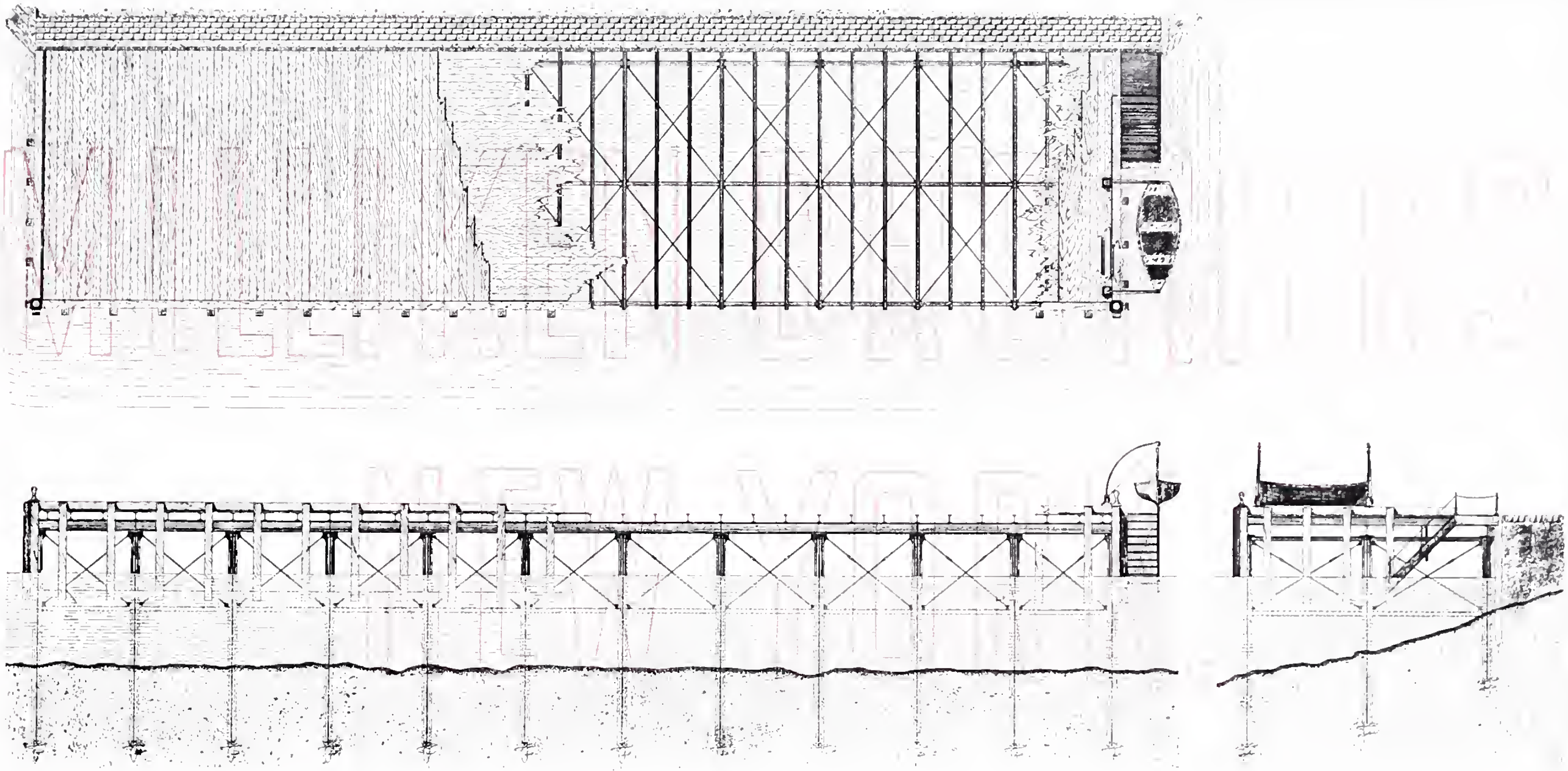
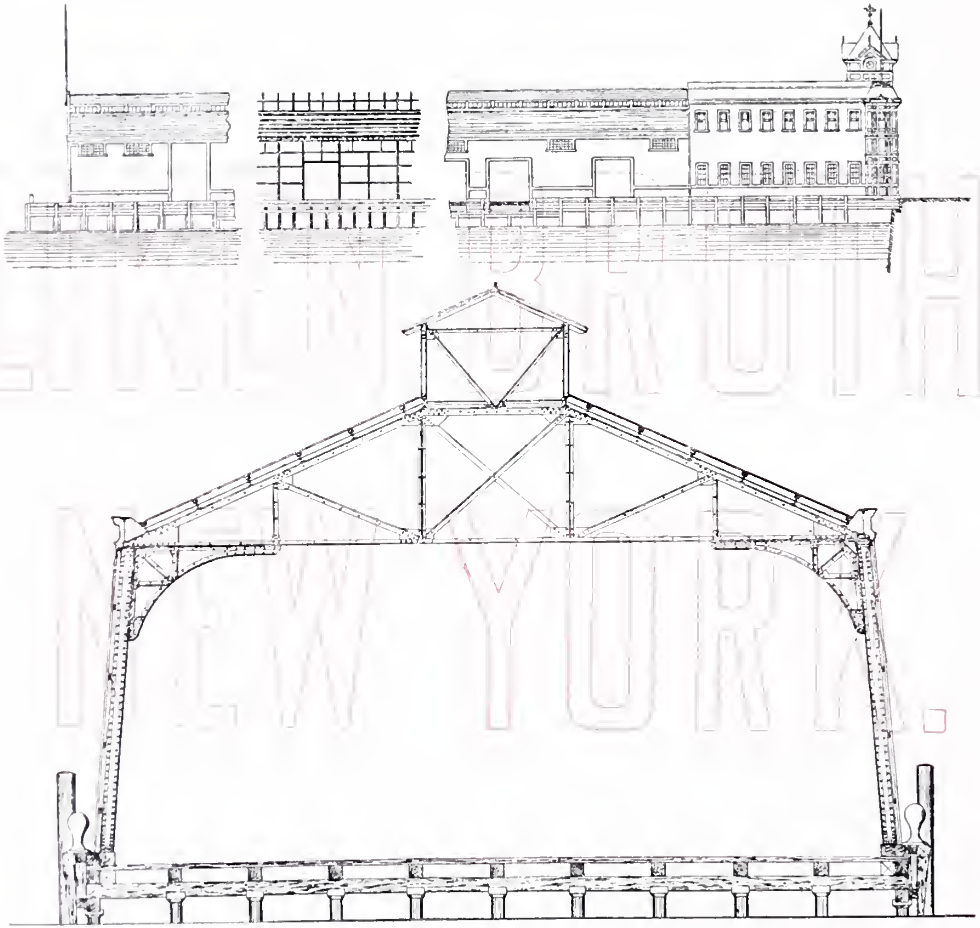


Plate No. 63.



STEEL WORK FURNISHED BY MILLIKEN BROTHERS.

STEEL WORK FURNISHED BY MILLIKEN BROTHERS.

RAILWAY AND HIGHWAY BRIDGES.

The use of wood or of wood and iron for the supporting members in bridge building is now entirely obsolete, and all bridges of any importance are constructed entirely of steel.

We are particularly well fitted to handle bridge work of any magnitude and for very quick delivery.

On the following pages we give our Standard Specification for both railway and highway bridges.

We desire to call particular attention to the general data which we require on both kinds of bridges to enable us to intelligently estimate on the work. We particularly request, in order to save time, that customers see that all of this information is furnished to us.

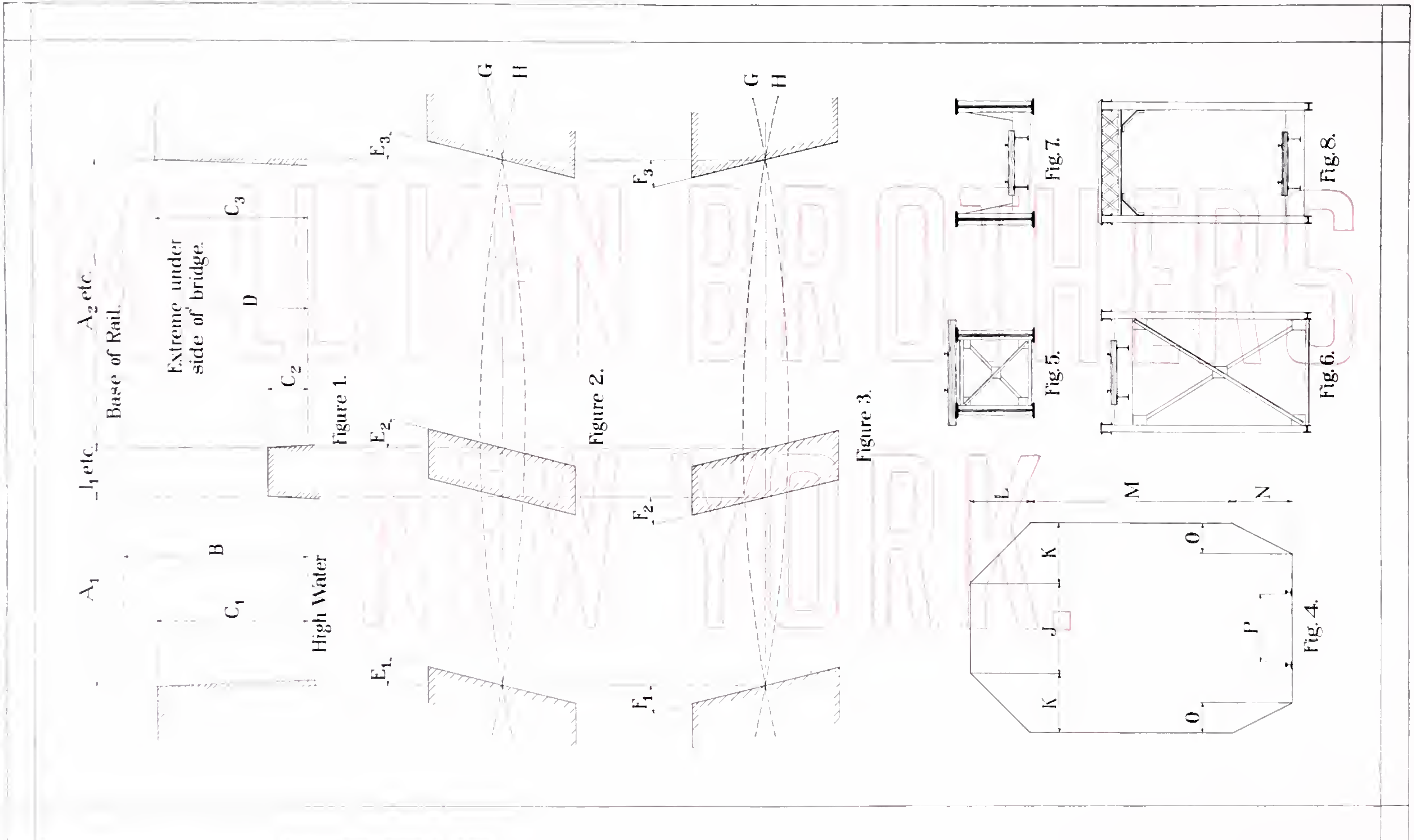
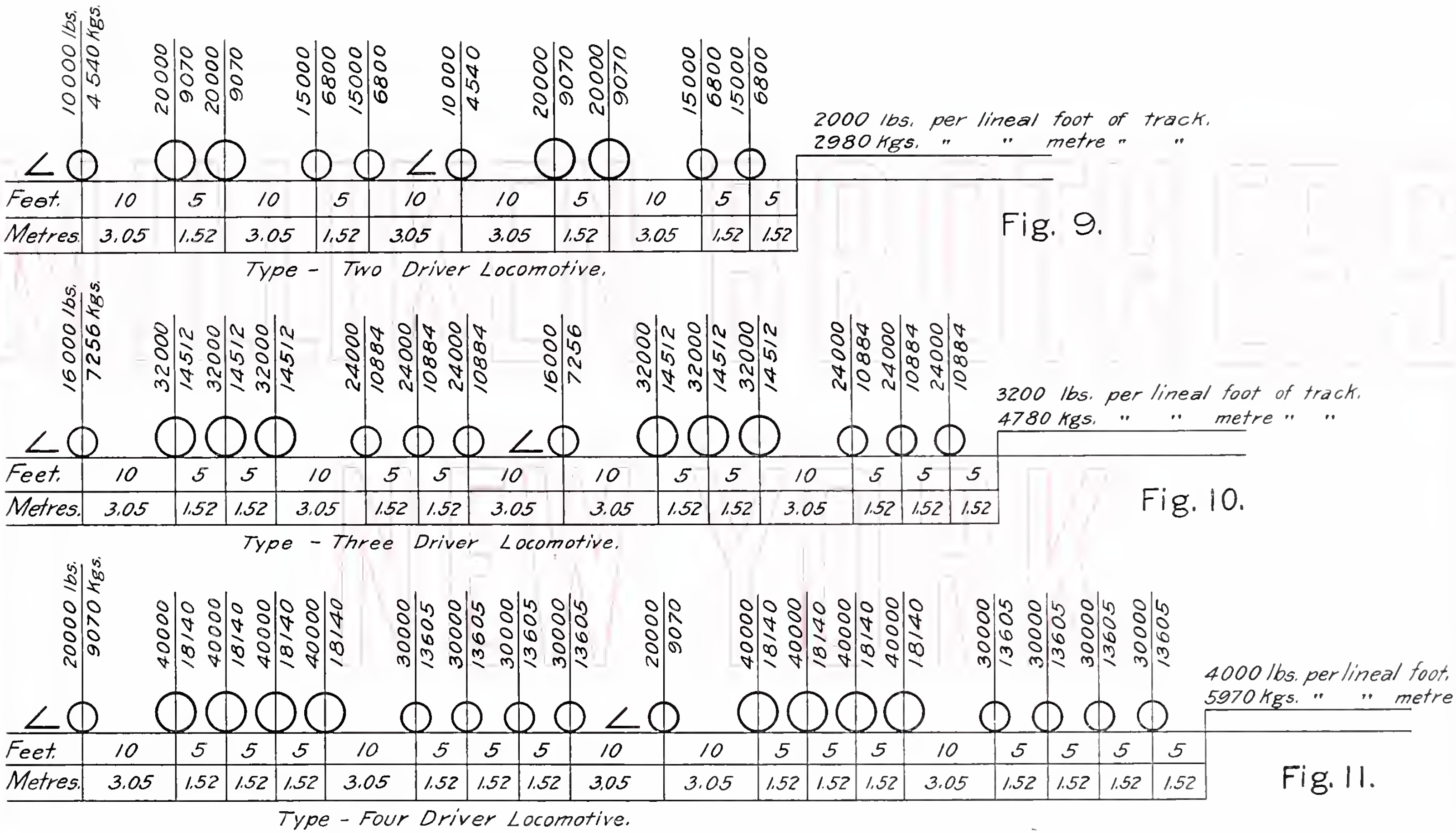
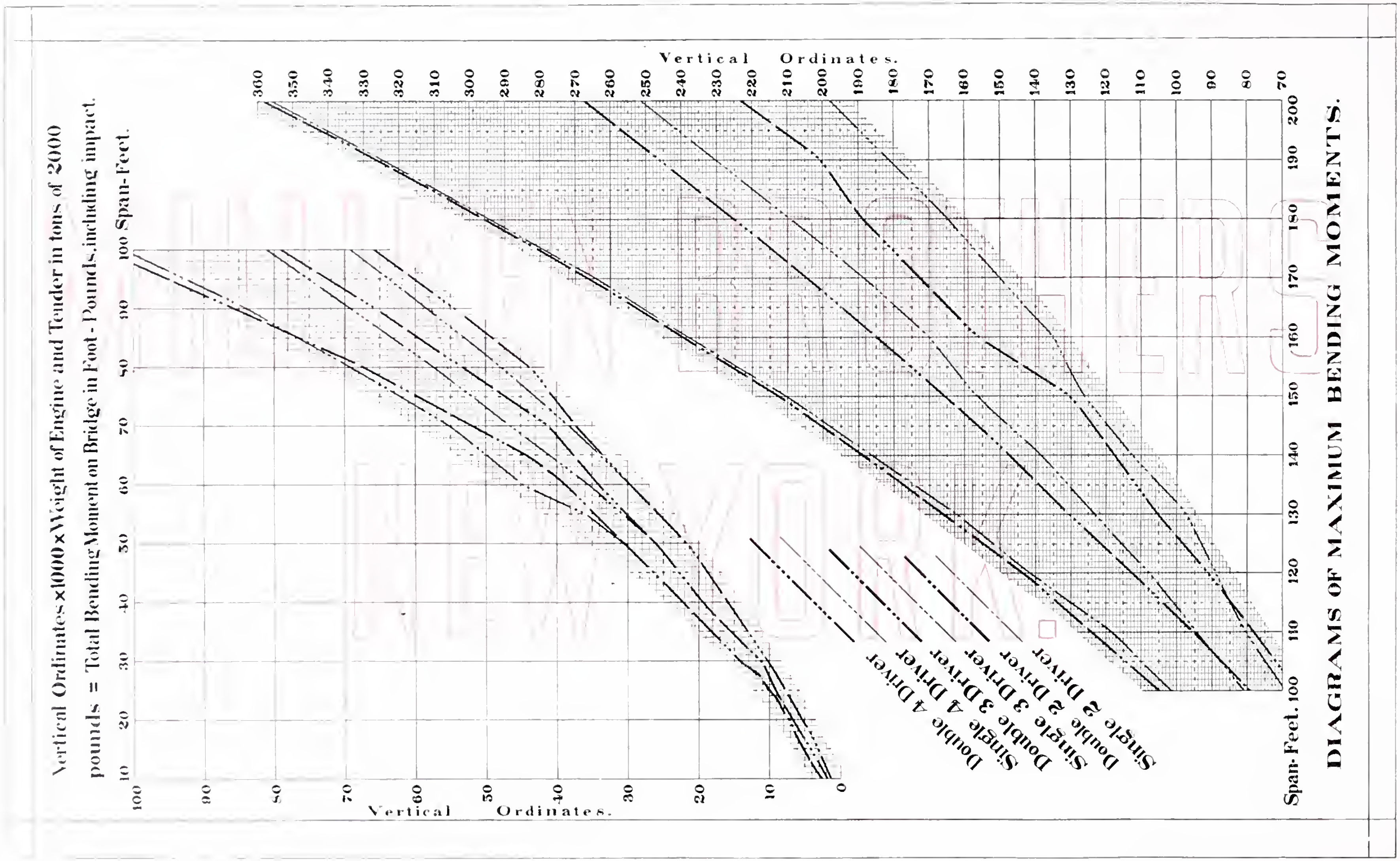

Base of Rail.
A1 etc.
A2 etc.
A1
B
C1
C2
C3
D
Extreme under side of bridge.
High Water
Figure 1.
E1.
E2.
E3.
G
H
Figure 2.
F1.
F2.
F3.
Figure 3.
Fig. 4.
L
M
N
K
J
O
P
Fig. 5.
Fig. 6.
Fig. 7.
Fig. 8.

Plate No. 65.



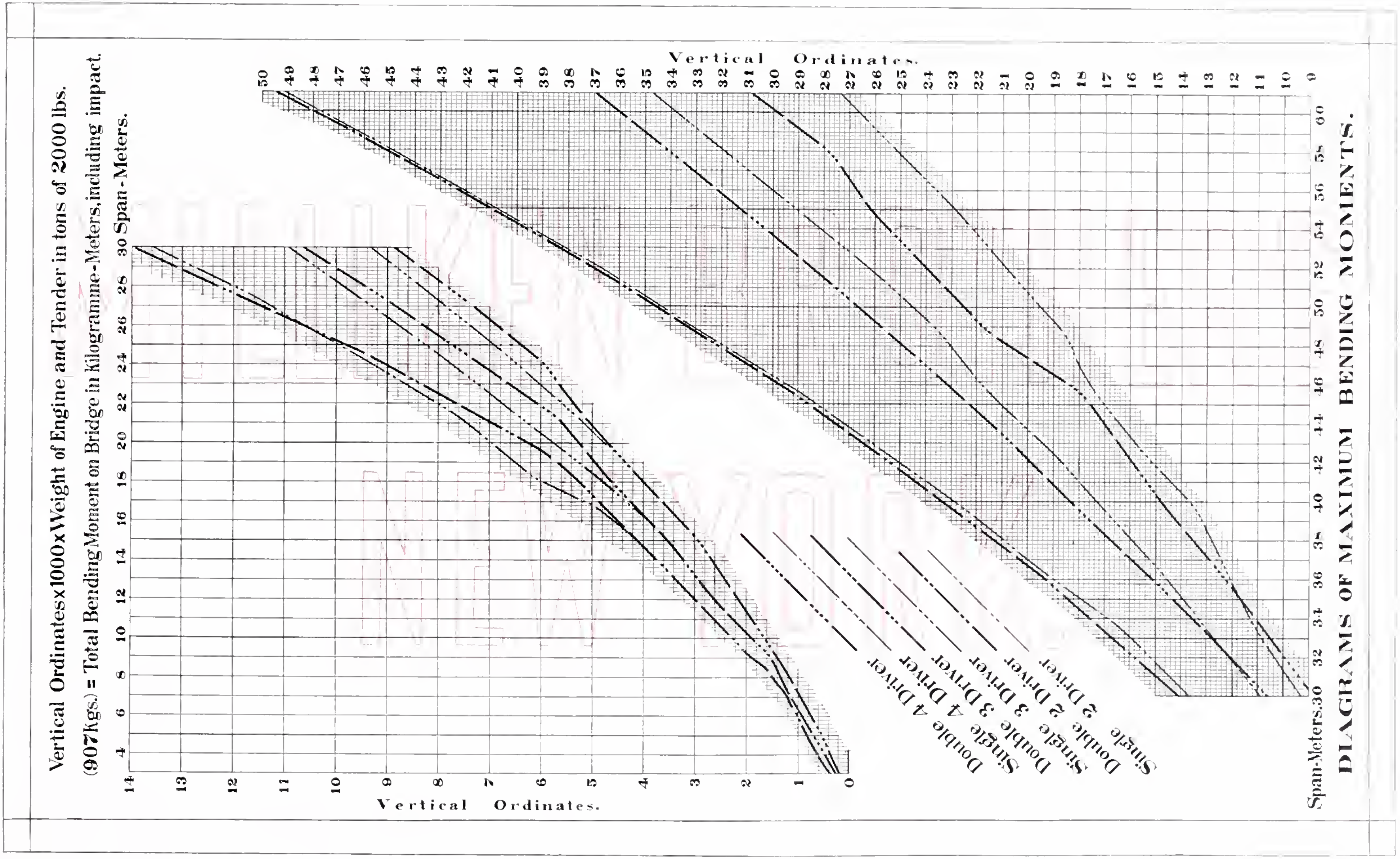
10000 lbs.
4540 Kgs.
20000 9070 20000 9070 15000 6800 15000 6800 10000 4540 20000 9070 20000 9070 15000 6800 15000 6800
2000 lbs. per lineal foot of track.
2980 Kgs. " " metre " "
Feet. 10 5 10 5 10 10 5 10 5 5
Metres. 3.05 1.52 3.05 1.52 3.05 3.05 1.52 3.05 1.52 1.52
Type – Two Driver Locomotive.
Fig. 9.
16000 lbs.
7256 Kgs.
32000 14512 32000 14512 32000 14512 24000 10884 24000 10884 24000 10884 16000 7256 32000 14512 32000 14512 32000 14512 24000 10884 24000 10884 24000 10884
3200 lbs. per lineal foot of track.
4780 Kgs. " " metre " "
Feet. 10 5 5 10 5 5 10 10 5 5 10 5 5 5
Metres. 3.05 1.52 1.52 3.05 1.52 1.52 3.05 3.05 1.52 1.52 3.05 1.52 1.52 1.52
Type – Three Driver Locomotive.
Fig. 10.
20000 lbs.
9070 Kgs.
40000 18140 40000 18140 40000 18140 40000 18140 30000 13605 30000 13605 30000 13605 30000 13605 20000 9070 40000 18140 40000 18140 40000 18140 40000 18140 30000 13605 30000 13605 30000 13605 30000 13605
4000 lbs. per lineal foot.
5970 Kgs. " " metre
Feet. 10 5 5 5 10 5 5 5 10 10 5 5 5 10 5 5 5 5
Metres. 3.05 1.52 1.52 1.52 3.05 1.52 1.52 1.52 3.05 3.05 1.52 1.52 1.52 3.05 1.52 1.52 1.52 1.52
Type – Four Driver Locomotive.
Fig. 11.

Plate No. 66.



DIAGRAMS OF MAXIMUM BENDING MOMENTS.
Vertical Ordinates × 1000 × Weight of Engine and Tender in tons of 2000 pounds = Total Bending Moment on Bridge in Foot-Pounds, including impact.
Vertical Ordinates.
Vertical Ordinates.
Span-Feet.
Span-Feet.
Single 2 Driver
Double 2 Driver
Single 3 Driver
Double 3 Driver
Single 4 Driver
Double 4 Driver

Plate No. 67.



Vertical Ordinates x 1000 x Weight of Engine and Tender in tons of 2000 lbs.
(907 kgs.) = Total Bending Moment on Bridge in Kilogramme-Meters, including impact.
Span-Meters.
Vertical Ordinates.
Vertical Ordinates.
Span-Meters.
Single 2 Driver
Double 2 Driver
Single 3 Driver
Double 3 Driver
Single 4 Driver
Double 4 Driver
DIAGRAMS OF MAXIMUM BENDING MOMENTS.

Table No. 42.

Coefficients of Impact.

AMERICAN—$I = \frac{V^2}{32.2\,L + V^2}$

I = Impact Coefficient
V = Velocity in feet (66) per second.
L = Length of load in feet.

METRIC—$I = \frac{V^2}{9.8\,L + V^2}$

I = Impact Coefficient.
V = Velocity in Metres (20.1) per second.
L = Length of load in metres.

L Feet	L Metres	I	L Feet	L Metres	I	L Feet	L Metres	I	L Feet	L Metres	I	L Feet	L Metres	I
5	1.52	.964	30	9.14	.818	55	16.76	.711	80	24.38	.628	125	38.10	.519
6	1.83	.958	31	9.45	.813	56	17.07	.707	81	24.69	.625	130	39.62	.509
7	2.13	.951	32	9.75	.809	57	17.37	.704	82	24.99	.622	135	41.15	.500
8	2.44	.944	33	10.06	.804	58	17.68	.700	83	25.30	.620	140	42.67	.491
9	2.74	.938	34	10.36	.800	59	17.98	.695	84	25.60	.617	145	44.20	.482
10	3.05	.932	35	10.67	.796	60	18.29	.693	85	25.91	.614	150	45.72	.474
11	3.35	.925	36	10.97	.791	61	18.59	.689	86	26.21	.611	155	47.24	.466
12	3.66	.919	37	11.28	.786	62	18.90	.686	87	26.52	.608	160	48.77	.458
13	3.96	.913	38	11.58	.781	63	19.20	.682	88	26.82	.606	165	50.29	.450
14	4.27	.907	39	11.89	.776	64	19.51	.679	89	27.13	.603	170	51.82	.443
15	4.57	.901	40	12.19	.772	65	19.81	.675	90	27.43	.600	175	53.34	.436
16	4.88	.894	41	12.50	.768	66	20.12	.672	91	27.74	.597	180	54.86	.429
17	5.18	.888	42	12.80	.763	67	20.42	.668	92	28.04	.595	185	56.39	.422
18	5.49	.883	43	13.11	.759	68	20.73	.665	93	28.35	.592	190	57.91	.416
19	5.79	.878	44	13.41	.755	69	21.03	.662	94	28.65	.590	195	59.44	.409
20	6.10	.872	45	13.72	.751	70	21.34	.659	95	28.96	.587	200	60.96	.403
21	6.40	.866	46	14.02	.747	71	21.64	.656	96	29.26	.585	210	64.01	.392
22	6.71	.860	47	14.33	.742	72	21.95	.652	97	29.57	.582	220	67.06	.381
23	7.01	.855	48	14.63	.738	73	22.25	.649	98	29.87	.580	230	70.10	.370
24	7.32	.850	49	14.94	.734	74	22.56	.646	99	30.18	.577	240	73.15	.360
25	7.62	.844	50	15.24	.730	75	22.86	.643	100	30.48	.575	250	76.20	.351
26	7.92	.839	51	15.54	.727	76	23.16	.640	105	32.00	.563	260	79.25	.342
27	8.23	.834	52	15.85	.723	77	23.47	.637	110	33.53	.551	270	82.30	.334
28	8.53	.828	53	16.15	.719	78	23.77	.634	115	35.05	.540			
29	8.84	.823	54	16.46	.715	79	24.08	.631	120	36.58	.529			

Wind Pressure.

AMERICAN — $P = \frac{V^2}{250}$

P = Pressure in pounds per square foot.
V = Velocity in miles per hour.

METRIC — $P = \frac{V^2}{133}$

P = Pressure in kilograms per square meter.
V = Velocity in kilometers per hour.

V miles per hour	P lbs. per sq. foot	V kilometers per hour	P kg. per sq. M.
30	3.6	48.3	17.5
40	6.4	64.4	31.2
50	10.0	80.5	48.7
60	14.4	96.6	70.2
70	19.6	112.7	95.5
80	25.6	128.7	124.7
90	32.4	144.8	157.9
100	40.0	160.9	194.9
105	44.1	169.0	215.0
110	48.4	177.0	235.8
115	52.9	185.1	257.9
120	57.6	193.1	280.6

Table No. 43.

Centrifugal Coefficients.

AMERICAN — $C = \frac{V^2}{32.2\,R}$

C = Centrifugal Coefficient.
V = Velocity in feet per second = 66-3d
R = Radius of Curve in feet.

METRIC — $C = \frac{V^2}{9.8\,R}$

C = Centrifugal Coefficient.
V = Velocity in metres per second = 20.1-.9d
R = Radius of Curve in metres.

d Degree of Curve	C	R in feet	V in feet	R in metres	V in metres
1	.022	5730	63	1747	19.2
2	.039	2865	60	873	18.3
3	.053	1910	57	582	17.4
4	.063	1433	54	437	16.5
5	.070	1146	51	349	15.6
6	.075	955	48	291	14.7
7	.077	819	45	250	13.8
8	.076	717	42	219	12.9
9	.074	637	39	194	12.0
10	.070	574	36	175	11.1
11	.065	522	33	159	10.2
12	.058	478	30	146	9.3
13	.051	442	27	135	8.4
14	.044	410	24	125	7.5
15	.036	383	21	117	6.6

Elevation of Outer Rail.

AMERICAN — $E = \frac{GS^2}{32.2\,R}$

E = Elevation of outer rail in feet.
G = Gauge in feet 4.71
S = Speed of train in feet per second = 37-1.5d.
R = Radius of Curve in feet.

METRIC — $E = \frac{GS^2}{9.8\,R}$

E = Elevation of outer rail in metres.
G = Gauge in metres 1.44
S = Speed of train in metres per second = 11.1-.44d.
R = Radius of Curve in metres.

d Degree of Curve	R in feet	S in feet.	E in feet	R in metres	S in metres	E in metres
1	5730	35.5	.032	1747	10.66	.0096
2	2865	34.0	.058	873	10.22	.0176
3	1910	32.5	.081	582	9.78	.0241
4	1433	31.0	.098	437	9.34	.0294
5	1146	29.5	.111	349	8.90	.0333
6	955	28.0	.120	291	8.46	.0361
7	819	26.5	.126	250	8.02	.0378
8	717	25.0	.127	219	7.58	.0385
9	637	23.5	.127	194	7.14	.0385
10	574	22.0	.123	175	6.70	.0376
11	522	20.5	.118	159	6.26	.0361
12	478	19.0	.111	146	5.82	.0341
13	442	17.5	.101	135	5.38	.0314
14	410	16.0	.091	125	4.94	.0286
15	383	14.5	.080	117	4.50	.0254

Deductive Areas.

Area to be deducted for each Rivet Hole from punched plates or shapes to obtain net areas.

AMERICAN

Deductive Areas in square inches.

Thickness of metal in inches.	Diameter of Rivet in inches. 5/8	3/4	7/8
1/4	.19	.22	.25
5/16	.23	.27	.31
3/8	.28	.33	.38
7/16	.33	.38	.44
1/2	.38	.44	.50
9/16	.42	.49	.56
5/8	.47	.55	.63
11/16	.56	.64	.73
3/4	.61	.70	.80
13/16	.66	.76	.86
7/8	.71	.82	.93

METRIC

Deductive Areas in square c.m.

Thickness of metal in m.m.	Diameter of Rivet in m.m. 15.9	19.1	22.2
6.4	1.22	1.42	1.62
8.0	1.53	1.77	2.03
9.5	1.81	2.13	2.41
11.1	2.12	2.48	2.82
12.7	2.43	2.84	3.23
14.3	2.73	3.19	3.63
15.9	3.03	3.55	4.04
17.5	3.61	4.16	4.71
19.1	3.95	4.55	5.15
20.7	4.27	4.90	5.58
22.2	4.58	5.30	5.98

Table No. 44.

Permissible Compressive Strains.

AMERICAN.

r = least radius of gyration in inches. l = length in inches.

Pounds per sq. inch.

$\frac{l}{r}$	$20000-80\frac{l}{r}$	$20000-100\frac{l}{r}$	$20000-130\frac{l}{r}$	$\frac{l}{r}$	$20000-80\frac{l}{r}$	$20000-100\frac{l}{r}$	$20000-130\frac{l}{r}$
10	19200	19000	18700	68	14560	13200	11160
12	19040	18800	18440	70	14400	13000	10900
14	18880	18600	18180	72	14240	12800	10640
16	18720	18400	17920	74	14080	12600	10380
18	18560	18200	17660	76	13920	12400	10120
20	18400	18000	17400	78	13760	12200	9860
22	18240	17800	17140	80	13600	12000	9600
24	18080	17600	16880	82	13440	11800	9340
26	17920	17400	16620	84	13280	11600	9080
28	17760	17200	16360	86	13120	11400	8820
30	17600	17000	16100	88	12960	11200	8560
32	17440	16800	15840	90	12800	11000	8300
34	17280	16600	15580	92	12640	10800	8040
36	17120	16400	15320	94	12480	10600	7780
38	16960	16200	15060	96	12320	10400	7520
40	16800	16000	14800	98	12160	10200	7260
42	16640	15800	14540	100	12000	10000	7000
44	16480	15600	14280	105	11600	9500	6350
46	16320	15400	14020	110	11200	9000	5700
48	16160	15200	13760	115	10800	8500	5050
50	16000	15000	13500	120	10400	8000	4400
52	15840	14800	13240	125	10000	7500	3750
54	15680	14600	12980	130	9600	7000	3100
56	15520	14400	12720	135	9200	6500	2450
58	15360	14200	12460	140	8800	6000	1800
60	15200	14000	12200	145	8400	5500	1150
62	15040	13800	11940	155	7600	4500	
64	14880	13600	11680	165	6800	3500	
66	14720	13400	11420	175	6000	2500	

METRIC.

r = least radius of gyration in millimeters. l = length in millimeters.

Kilograms per sq. c.m.

$\frac{l}{r}$	$1406-5.6\frac{l}{r}$	$1406-7.03\frac{l}{r}$	$1406-9.14\frac{l}{r}$	$\frac{l}{r}$	$1406-5.6\frac{l}{r}$	$1406-7.03\frac{l}{r}$	$1406-9.14\frac{l}{r}$
10	1350	1336	1315	68	1025	928	784
12	1339	1322	1296	70	1014	914	766
14	1328	1308	1278	72	1003	900	748
16	1316	1293	1260	74	992	886	730
18	1305	1279	1241	76	980	872	712
20	1294	1265	1223	78	969	858	693
22	1283	1251	1205	80	958	844	675
24	1272	1237	1187	82	947	830	656
26	1260	1223	1169	84	936	816	638
28	1249	1209	1150	86	924	801	620
30	1238	1195	1132	88	913	787	601
32	1227	1181	1113	90	902	773	583
34	1216	1167	1095	92	891	759	565
36	1204	1153	1077	94	880	745	547
38	1193	1139	1058	96	868	731	529
40	1182	1125	1040	98	857	717	510
42	1171	1111	1022	100	846	703	492
44	1160	1097	1004	105	818	668	446
46	1148	1083	986	110	790	633	401
48	1137	1069	967	115	762	598	355
50	1126	1054	949	120	734	562	309
52	1115	1040	931	125	706	527	264
54	1104	1026	913	130	678	492	218
56	1092	1012	895	135	650	458	172
58	1081	998	876	140	622	422	126
60	1070	984	858	145	594	386	81
62	1059	970	839	155	538	316	
64	1048	956	821	165	482	246	
66	1036	942	803	175	426	176	

Table No. 45.

Maximum Bending Moments and Bearing Values of Pins.

AMERICAN								METRIC							
with extreme fibre stress of 25000 pounds per square inch and bearing value of 28000 pounds per square inch.								with extreme fibre stress of 1758 kilograms per square centimeter and bearing value of 1968 kilograms per square centimeter.							
Diameter of Pin in inches.	Area of Pin in square inches.	Moments in inch pounds.	Bearing Value for 1 inch thickness of Plate.	Diameter of Pin in inches.	Area of Pin in square inches.	Moments in inch pounds.	Bearing Value for 1 inch thickness of Plate.	Diameter of Pin in c.m.	Area of Pin in square c.m.	Moments in kg. c.m.	Bearing Value for 2.54 c.m. thickness of Plate.	Diameter of Pin in c.m.	Area of Pin in square c.m.	Moments in kg. c.m.	Bearing Value for 2.54 c.m. thickness of Plate.
1	0.785	2450	28000	$4\frac{1}{2}$	15.904	223700	126000	2.540	5.06	2820	12700	11.430	102.61	257700	57300
$1\frac{1}{8}$	0.994	3500	31500	$4\frac{5}{8}$	16.800	242800	129500	2.857	6.41	4030	14400	11.748	108.39	280100	58800
$1\frac{1}{4}$	1.227	4790	35000	$4\frac{3}{4}$	17.721	263000	133000	3.175	7.92	5520	16000	12.065	114.33	303000	60400
$1\frac{3}{8}$	1.485	6380	38500	$4\frac{7}{8}$	18.665	284400	136500	3.493	9.58	7350	17500	12.383	120.42	328000	62000
$1\frac{1}{2}$	1.767	8280	42000	5	19.635	306800	140000	3.810	11.40	9540	19100	12.700	126.68	353400	63600
$1\frac{5}{8}$	2.074	10500	45500	$5\frac{1}{8}$	20.629	330400	143500	4.128	13.38	12100	20700	13.018	133.09	381000	65200
$1\frac{3}{4}$	2.405	13200	49000	$5\frac{1}{4}$	21.648	355200	147000	4.445	15.52	15200	22300	13.335	139.66	409000	66800
$1\frac{7}{8}$	2.761	16200	52500	$5\frac{3}{8}$	22.691	381100	150500	4.763	17.81	18700	23900	13.653	146.39	439000	68400
2	3.142	19600	56000	$5\frac{1}{2}$	23.758	408300	154000	5.080	20.27	22600	25400	13.970	153.28	470400	70000
$2\frac{1}{8}$	3.547	23600	59500	$5\frac{5}{8}$	24.850	436800	157500	5.398	22.88	27200	27100	14.288	160.32	503000	71600
$2\frac{1}{4}$	3.976	28000	63000	$5\frac{3}{4}$	25.967	466600	161000	5.715	25.65	32300	28600	14.605	167.53	537500	73200
$2\frac{3}{8}$	4.430	32900	66500	$5\frac{7}{8}$	27.109	497700	164500	6.033	28.58	37900	30200	14.923	174.89	574000	74800
$2\frac{1}{2}$	4.909	38400	70000	6	28.274	530200	168000	6.350	31.67	44300	31800	15.240	182.41	610800	76400
$2\frac{5}{8}$	5.412	44400	73500	$6\frac{1}{8}$	29.465	564000	171500	6.667	34.92	51200	33400	15.558	190.10	650000	78000
$2\frac{3}{4}$	5.940	51000	77000	$6\frac{1}{4}$	30.680	599200	175000	6.985	38.32	58800	35000	15.875	197.94	690300	79600
$2\frac{7}{8}$	6.492	58300	80500	$6\frac{3}{8}$	31.919	635900	178500	7.303	41.88	67200	36600	16.193	205.93	733000	81200
3	7.069	66300	84000	$6\frac{1}{2}$	33.183	674000	182000	7.620	45.61	76400	38200	16.510	214.07	776400	82800
$3\frac{1}{8}$	7.670	74900	87500	$6\frac{5}{8}$	34.472	713700	185500	7.938	49.48	86300	39800	16.828	222.40	822000	84400
$3\frac{1}{4}$	8.296	84300	91000	$6\frac{3}{4}$	35.785	754800	189000	8.255	53.52	97000	41400	17.145	230.87	869500	86000
$3\frac{3}{8}$	8.946	94400	94500	$6\frac{7}{8}$	37.122	797500	192500	8.573	57.72	108800	42900	17.463	239.50	918000	87600
$3\frac{1}{2}$	9.621	105200	98000	7	38.485	841900	196000	8.890	62.07	121200	44500	17.780	248.29	969900	89200
$3\frac{5}{8}$	10.321	116900	101500	$7\frac{1}{2}$	44.179	1035400	210000	9.208	66.59	134800	46100	19.050	285.03	1192800	95600
$3\frac{3}{4}$	11.045	129400	105000	8	50.265	1256600	224000	9.525	71.26	149000	47700	20.320	324.29	1448000	102000
$3\frac{7}{8}$	11.793	142800	108500	$8\frac{1}{2}$	56.745	1507300	238000	9.843	76.08	164500	49300	21.590	366.10	1736000	108400
4	12.566	157100	112000	9	63.617	1789200	252000	10.160	81.07	181000	50800	22.860	410.43	2061000	114500
$4\frac{1}{8}$	13.364	172300	115500	10	78.540	2454400	280000	10.478	86.22	198500	52500	25.400	506.71	2827000	127300
$4\frac{1}{4}$	14.186	188400	119000	11	95.033	3266800	308000	10.795	91.52	217000	54100	27.940	613.12	3763000	140000
$4\frac{3}{8}$	15.033	205500	122500	12	113.097	4241200	336000	11.113	96.99	236800	55700	30.480	729.66	4886000	153000

Table No. 46.

Permissible Shearing Strains on Web Plates.

AMERICAN. $P = 15000 - 100\frac{d}{t}$

P Permissible Strain in pounds per square inch.
d Unsupported distance between chord angles or stiffeners in inches.
t Thickness of Web in inches.

d in inches	t in inches: 5/16	3/8	7/16	1/2	9/16	5/8	3/4	7/8
24	7300	8600	9500	10200	10700	11200	11800	12300
26	6700	8100	9100	9800	10400	10800	11500	12000
28	6000	7500	8600	9400	10000	10500	11300	11800
30	5400	7000	8200	9000	9700	10200	11000	11600
32	4700	6500	7700	8600	9300	9900	10700	11300
34	4100	5900	7200	8200	9000	9600	10500	11100
36	3500	5400	6800	7800	8600	9200	10200	10900
39	2500	4600	6100	7200	8100	8800	9800	10500
42	1600	3800	5400	6600	7500	8300	9400	10200
45	600	3000	4700	6000	7000	7800	9000	9900
48		2200	4000	5400	6500	7300	8600	9500
51		1400	3300	4800	5900	6800	8200	9200
54		600	2700	4200	5400	6400	7800	8800
57			2200	3600	4900	5900	7400	8500
60			1300	3000	4300	5400	7000	8100
64				2200	3600	4800	6500	7700
68				1400	2900	4100	5900	7200
72				600	2200	3500	5400	6800
76					1500	2800	4900	6300
80					800	2200	4300	5900
84						1600	3800	5400
88						900	3300	5100
92							2700	4500
96							2200	4000
100							1700	3600

METRIC. $P = 1055 - 7.03\frac{d}{t}$

P Permissible Strain in kilograms per square centimeter
d Unsupported distance between chord angles or stiffeners in millimeters.
t Thickness of Web in millimeters.

d in m.m.	t in m.m.: 8.0	9.5	11.1	12.7	14.3	15.9	19.1	22.2
610	520	605	670	715	755	785	830	860
660	475	570	640	695	735	765	815	845
711	420	530	605	660	705	740	795	830
762	380	490	575	630	680	720	775	815
813	335	450	540	600	655	695	755	795
864	285	415	505	570	630	675	735	780
914	245	380	475	550	615	650	720	765
990	175	325	430	505	570	615	690	740
1067	105	265	380	465	530	585	660	715
1143	45	210	330	420	495	550	635	695
1219		155	285	380	455	515	605	670
1295		95	235	340	420	485	580	645
1372		40	185	295	380	450	550	620
1448			140	255	345	415	520	595
1524			90	210	315	380	495	575
1626				155	255	335	455	540
1727				100	205	290	420	510
1829				45	155	245	380	475
1930					105	200	345	445
2032					55	155	305	410
2134						110	270	380
2235						65	235	350
2337							195	315
2438							155	285
2540							120	250

Table No. 47.

Shearing and Bearing Value of Rivets.

AMERICAN.

Diameter of Rivet in inches.	Area of Rivet in sq. inches.	Single Shear at 12000 lbs.	Bearing Value for Different Thicknesses in Inches at 24000 lbs. per square inch.												
			1/4	5/16	3/8	7/16	1/2	9/16	5/8	11/16	3/4	13/16	7/8	15/16	1
3/8	.1100	1320	2250	2810	3380										
1/2	.1960	2360	3000	3750	4500	5250	6000								
5/8	.3070	3680	3750	4680	5620	6570	7500	8430	9360						
3/4	.4420	5300	4500	5620	6750	7870	9000	10120	11240	12370	13500				
7/8	.6010	7220	5250	6560	7880	9200	10500	11810	13120	14450	15750	17060	18370	19680	
1	.7850	9430	6000	7500	9000	10500	12000	13500	15000	16500	18000	19500	21000	22500	24000

METRIC

Diameter of Rivet in m.m.	Area of Rivet in sq. c.m.	Single Shear at 844 kg.	Bearing Value for Different Thicknesses in Millimeters at 1687 kg. per sq. c.m.												
			6.4	8.0	9.5	11.1	12.7	14.3	15.9	17.5	19.1	20.6	22.2	23.8	25.4
9.5	.71	600	1030	1280	1540										
12.7	1.27	1070	1360	1700	2050	2380	2720								
15.9	1.98	1670	1700	2130	2550	2980	3400	3830	4250						
19.1	2.85	2410	2040	2550	3060	3570	4080	4590	5100	5610	6120				
22.2	3.88	3280	2380	2980	3570	4170	4770	5360	5960	6550	7140	7740	8340	8940	
25.4	5.06	4270	2730	3410	4090	4770	5450	6130	6820	7500	8180	8850	9540	10220	10900

Bearing Values above and to the right of upper zigzag lines are greater than double shear.
" " below " " " left " lower " " " less " single "
Field Rivets will be considered as having values 83% of those given above.

STANDARD SPECIFICATION FOR RAILWAY BRIDGES.

GENERAL DATA REQUIRED.

1. General.—In order that a correct design may be made it will be necessary to have the following data to complete each particular case: see Plate 64, Fig. 1, 2, 3 and 4.

1st. Weight of locomotive and tender in tons of 2000 lbs.

2nd. A_1, A_2, A_3, etc. distances between abutments or piers.

3rd. B–Height from high water to base of rail.

4th. C_1, C_2, C_3, etc. Height from high water to top of masonry.

5th. D–Clear distance required from high water to extreme lower projections of bridge.

6th. E_1, E_2, E_3, etc–Right skew angle of abutments or piers.

7th. F_1, F_2, F_3, etc.–Left skew angle of abutments or piers.

8th. G–Degree of curvature or radius, if track is on a curve.

9th. H–Degree of curvature or radius, if track is on a curve.

10th. I_1, I_2, I_3, etc.–Width of intermediate piers if more than one span.

11th. J–Clearances required.

12th. K–Clearances required.

13th. L–Clearances required.

14th. M–Clearances required.

15th. N–Clearances required.

16th. O–Clearances required.

17th. P–Gauge between rails.

18th. Type of Locomotive.

19th. Type of Bridge.

20th. Whether bridge is single or double track.

21st. Grade, if track is not level.

22nd. Maximum speed at which trains will cross the bridge.

Items 1 and 2 cannot be assumed and must always be furnished. Items 3, 4 and 5 will be considered as unrestricted if they are not specified. In case any of the remainder of the items are not given the bridge will be designed on the following assumptions:

6th. E–Bridges will be assumed as square with abutments.

7th. F–Bridges will be assumed as square with abutments.

8th. G–Track will be assumed as straight.

9th. H–Track will be assumed as straight.

10th. I–Width of intermediate piers will be assumed to be built in conformity with detail of bridge shoes.

11th. J–Will be assumed as 6 ft. (1.83 M).

12th. K–Will be assumed as 4 ft. (1.22 M).

13th. L–Will be assumed as 5 ft. (1.52 M).

14th. M–Will be assumed as 10 ft. (3.05 M).

15th. N–Will be assumed as 5 ft. (1.52 M).

16th. O–Will be assumed as 2 ft. (.61 M).

17th. P–Gauge will be assumed as 4 ft. 8½ in. (1.43M).

18th. Locomotive will be assumed in accordance with paragraph 15.

19th. Bridge will be designed on the lines of most economical type in the absence of headroom or other limiting conditions being specified: (See paragraphs 2 to 13 inclusive).

20th. Bridge will be assumed as single track.

21st. Track will be assumed as level.

22nd. Maximum speed will be assumed as 45 miles (72.42 Km.) per hour.

TYPE OF BRIDGE.

Unless otherwise specified the following types of bridges will be generally adopted.

				AMERICAN.	METRIC.
2.	**Rolled Beams**		Spans	up to 30 ft.	up to 9.1 M
3.	**Riveted Plate or Latticed Girders**	(Single Track	"	30 ft. to 100 ft.	9.1 M to 30.5 M.
		(Double "	"	30 ft. to 80 ft.	9.1 M to 24.4 M.
4.	**Riveted Trusses**	(Single "	"	100 ft. to 175 ft.	30.5 M to 53.4 M.
		(Double "	"	80 ft. to 125 ft.	24.4 M to 38.1 M.
5.	**Pin Connected Trusses**	(Single "	"	over 175 ft.	over 53.4 M.
		(Double "	"	over 125 ft.	over 38.1 M.

6. Deck Bridges.—(See Plate 64, Fig. 5). Where headroom and length of span will permit, deck bridges, (that is bridges having the track ties rest directly on the top chords) will preferably be used.

7. Quarter Through.—(See Plate 64, Fig. 6). Where headroom will permit deck bridges, but the span is excessive, quarter through bridges (that is bridges having a floor system of cross girders and longitudinal stringers placed between the trusses just below the top chord with no cross bracing above the rails. but with a lateral system connecting the bottom chords) will be used.

8. Half Through.—(See Plate 64, Fig. 7). Where headroom will not permit deck bridges or quarter through bridges and the span is not excessive, then half through bridges (that is bridges with the floor system near the bottom chord and with no cross bracing above the rails) will be used.

9. Through.—(See Plate 64, Fig. 8). Where headroom will not permit deck or quarter through bridges and the span is excessive for half through, then through bridges (that is bridges with the floor system near the bottom chord and cross lateral bracing connecting the top chords) will be used.

10. Deck Bridges.—For deck bridges there will be a girder or truss for each rail, spaced generally 18 inches (46 c. m.) farther apart than the track rails.

11. Quarter Through.—For quarter through bridges the girders or trusses will be spaced as required by the span.

12. Half Through and Through.—For half through and through bridges the trusses will be spaced as required by the span or by the required train clearances.

13. Clearances.—The structure will be designed so as to conform with the required clearances.

For double track bridges the distance center to center of tracks will be assumed as 13 ft. (3.95 M.) unless a middle truss is used, in which case each track will have the same lateral clearances as required for a single track bridge. For bridges on a curve, provision must be made for the additional clearance required by a load 100 ft. (30.5 M.) long and 8 ft. (2.45 M.) wide.

The minimum distance center to center of trusses shall be $^1/_{20}$ of the Span.

LOADINGS.

The various parts of the structure will be proportioned to carry the following loads using the combinations of loadings and unit strains hereinafter specified.

14. Dead Load.—The entire weight of the structure consisting of all metal used in construction plus the weight of the ties, guards, rails, etc., which latter items shall be assumed to weigh 400 lbs. per lineal ft. (600 kg. per lineal meter) of track.

15. Live Loads.—A moving load on each track consisting of one or of two engines at the head of a uniformly distributed train load, assumed to travel in either direction and so placed as to give the maximum stress for each member. The engine and train loads will be as specified, or in case only the total weight of engine and tender is given, the various wheel loads and uniform load will be proportioned from total weight of engine and tender as given, in ratio to the unit loadings given in the following diagrams, Plate 65, Figs. 9, 10 and 11.

The type of the engine to be used should always be given, as the number of drivers is a very important factor in designing the structures, but in case this information is not supplied, a locomotive

of the 4 driver type will be used. The minimum live loads used will be a train load of 1,500 lbs. per lin. ft. (2,232 kg. per lin. M.) and 2 axle loads of 12,000 lbs. (5,440 kg.) each, 5 ft. (1.53 M.) centers. The tonnage given will be assumed to include both engine and tender. For maximum moments for 2 driver type over 30 tons, 3 driver over 45 tons and 4 driver over 55 tons see plates 66 and 67.

16. Impact.—The live load stresses shall be increased to provide for sudden application of loads from high speed trains, such increase to be determined by the following formula:

AMERICAN. (See table No. 42.)

$$I = \frac{V^2}{32.2\ L + V^2}$$

In which

I=Coefficient for determining the additional strain produced by impact.

V=Velocity of train in feet per second.

L=Length in feet of load which produces maximum stress in member.

METRIC. (See table No. 42.)

$$I = \frac{V^2}{9.8\ L + V^2}$$

In which

I=Coefficient for determining the additional strain produced by impact.

V=Velocity of train in meters per second.

L=Length in meters of load which produces maximum stress in member.

The impact coefficient shall in no case (excepting wind) be taken at less than .333.

The live load stress in the member shall be taken as $S\ (1 + I)$

Where

S=Live load stress before impact is added.

I=Impact coefficient.

Where temperature falls below freezing the live stresses must be increased 1% for each degree centigrade below freezing.

17. Wind Pressure.—The lateral bracing in all bridges shall be proportioned to carry such stresses to the abutments as may be produced by a wind pressure of

AMERICAN. (See table No. 42.)

$$P=\frac{V^2}{250}$$

Where

P=Pressure in lbs. per sq. ft.

V=Velocity of wind in miles per hour.

METRIC. (See table No. 42.)

$$P=\frac{V^2}{133}$$

Where

P=Pressure in kilos per sq. meter.

V=Velocity of wind in kilometers per hour.

18. Wind Impact.—The wind pressure shall be considered as acting on the actual exposed area of the trusses and floor system, and on a train 10 ft. (3.05 M) high, beginning 2 ft. 6 inches (0.76 M) above base of rail and assumed to be moving across the bridge. The wind pressure on the train is to be taken as a moving load and must also be increased by the impact coefficient.

19. Overturning.—For determining the anchorage to resist overturning, the wind must be considered as acting upon the empty bridge or upon the bridge and an empty train assuming the latter to weigh 800 lbs. per lineal foot (1200 kilos per lineal meter) of train.

20. Centrifugal.—For bridges on a curve the effects of a centrifugal force shall be computed for a speed of 45 miles (72.42 Km.) per hour on a straight run, reduced by curvature of track, by the following formula:

AMERICAN. (See table No. 43.)

$$C=\frac{V^2}{32.2\ R}$$

In which

C=Coefficient for determining centrifugal force.

V=Velocity of train in feet per second, assumed at 66–3d, where d=degree of curvature.

R=Radius of curvature in feet.

METRIC. (See table No. 43.)

$$C=\frac{V^2}{9.8\ R}$$

In which

C=Coefficient for determining centrifugal force.

V=Velocity of train in meters per second, assumed at 20.1–.9d where d=degree of curvature.

R=Radius of curvature in meters.

Degree of curvature d=number of degrees in angle subtended at the center by a chord 100 feet (30.5 M) long.

The centrifugal force shall be taken as acting horizontally at a height of 5 ft. (1.53 m.) above the base of rail and equal to

$$C\ (W+WI)$$

Where
C=Coefficient for centrifugal force.
W=Live load producing the centrifugal force.
I=Impact coefficient.

For bridges on a curve due allowance must be made for the train load standing still on the structure, as the outer rail being elevated, the center of gravity will be thrown off center toward the inner truss or girder. In case this produces larger stresses than the centrifugal force of the train under full speed, it shall be the determining factor. Both trusses shall be made of equal strength in either case.

For determining the elevation of the outer rail the following formula will be used:—

AMERICAN. (See table No. 43.)

$$E=\frac{GS^2}{32.2\ R}$$

Where

E=Elevation of outer rail in feet.

G=Gauge of track in feet.

R=Radius of curvature in feet.

S=Mean velocity in feet per second to allow for equal wear on rails, and assumed at $37-1.5d$ where d=degree of curvature.

METRIC. (See table No. 43.)

$$E=\frac{GS^2}{9.8\ R}$$

Where

E=Elevation of outer rail in meters.

G=Gauge of track in meters.

R=Radius of curvature in meters.

S=Mean velocity in meters per second to allow for equal wear on rails, and assumed at $11.1-.44d$ where d=degree of curvature.

21. Traction.—A tractive force due to suddenly stopping the train shall be considered as acting horizontally along the structure. Such force shall be taken at 20% of the moving load and applied at base of rail. This applies particularly to trestle towers, deck bridges supported at the lower chord and similar structures.

QUALITY OF MATERIAL.

22. Process of Manufacture.—All steel shall be made by the Open Hearth process. Maximum phosphorus .08 per cent. Steel shall be of two grades, RIVET and MEDIUM.

23. Rivet Steel.—The ULTIMATE STRENGTH of rivet steel shall be from 48,000 to 58,000 lbs. per sq. inch, (3370 to 4080 kilograms per sq. centimetre).

The Elastic Limit shall not be less than one-half of the ultimate strength.

The Percentage of Elongation shall be equal to:—

AMERICAN.	METRIC.
$\dfrac{1{,}400{,}000}{\text{Ult. Strength}}$ in pounds per sq. inch.	$\dfrac{98{,}000}{\text{Ult. Strength}}$ in kg. per sq. c. m.

A Bending Test shall not show sign of fracture on the outside of bent portion when the specimen is bent to 180 degrees flat on itself.

24. Medium Steel.—The Ultimate Strength of medium steel shall be from 60,000 to 70,000 lbs. per sq. inch (4220 to 4920 kilograms per sq. centimetre).

The Elastic Limit shall not be less than one-half the ultimate strength.

The Percentage of Elongation shall be equal to:—

AMERICAN.	METRIC.
$\dfrac{1{,}400{,}000}{\text{Ult. Strength}}$ pounds per sq. inch.	$\dfrac{98{,}000}{\text{Ult. Strength}}$ kg. per sq. c. m.

25. Pins.—Pins shall be made from Medium Steel which shall meet with all the requirements of such grade, except that the elongation may be 5 per cent. less than that specified for such grade, as determined on a test piece, the center of which shall be one inch from the surface of the bar.

26. Finish.—Finished bars shall be free from injurious flaws, cracks or seams, and have a workmanlike finish.

27. Marking.—Every finished piece of steel shall be stamped with the blow or melt number.

28. Test Pieces.—Standard test pieces cut from the finished material in the condition in which it leaves the rolls shall be used for determining the tensile strength, limit of elasticity and ductility of steel which is not to be annealed or otherwise treated.

29. Annealed Test Pieces.—If the material is to be annealed or otherwise treated before using, the test pieces shall be similarly treated before testing.

30. Eye Bar Tests.—Full sized eye bars shall show an ultimate strength of not less than 55,000 pounds per square inch (3870 kg. per sq. c.m.). Bars which fail in the head but which otherwise meet the requirements of this specification, will not be cause for the rejection of the sizes of which they are representative, provided not more than $\frac{1}{3}$ of the bars so break.

31. Variation in Weight.—A variation in weight or cross section of more than $2\frac{1}{2}$ per cent. from that specified may be sufficient cause for rejection, except in the case of plates which will be covered by the prevailing permissible variations at the point of manufacture.

32. Steel Castings.—Steel Castings shall be of a workmanlike finish and shall be free from injurious defects and the metal must be uniform in character.

33. Cast Iron.—All castings shall be of tough grey iron, free from injurions cold shuts or blow holes and shall have a workmanlike finish. A sample piece one inch (25.4 m.m.) square cast from the same heat of metal in sand moulds shall support 500 pounds (227 kg.) applied at the center between supports 4 ft. 6 in. (137 c.m.) apart, when tested in the rough bar.

34. Tests.—All tests and inspections and acceptance shall be made at the places, and during the time of manufacture. The number of full size eye bars to be tested must be determined by the Inspecting Engineer. Eye bars tested to destruction and fulfilling the specification requirements will be charged for at their value and credit given for the scrap value of the material.

PROPORTIONING SECTIONS.

35. Maximum Stresses.—The maximum stresses for any member shall be determined by the following:—

For straight bridges, Dead + Live + Live Impact + Wind + Wind Impact + Traction.

For curved bridges, Dead + Live + Live Impact + Wind + Wind Impact + Traction + Centrifugal.

36. Direct and Bending Combined.—Members subject to both direct stresses and bending stresses shall be proportioned for the full direct stress plus one-half the bending stress or for one-half the direct stress plus full bending stress, the greater being used.

37. Alternate Stresses.—Members subject to alternate stresses of tension and compression shall be proportioned to resist either kind of stress or the sum of the greater plus three quarters of the lesser, the maximum result to govern.

38. Dead Load Counteracting Live.—Where the dead load produces stresses opposite to those from the live load $^{8}/_{10}$ of these dead stresses may be deducted from the live load stresses and the member proportioned for the difference.

39. Compression Members.—Members in compression shall be proportioned so that the maximum strain per square inch gross area shall not exceed the following:—

AMERICAN. (See table No. 44.)

In pounds per square inch.

Both ends fixed	$20{,}000-80\frac{l}{r}$
One end fixed, other end hinged	$20{,}000-100\frac{l}{r}$
Both ends hinged	$20{,}000-130\frac{l}{r}$

In which

l=length in inches.

r=least radius of gyration in inches.

METRIC. (See table No. 44.)

In kilograms per sq. c. m.

Both ends fixed	$1{,}406-5.62\frac{l}{r}$
One end fixed, other end hinged	$1{,}406-7.03\frac{l}{r}$
Both ends hinged	$1{,}406-9.14\frac{l}{r}$

In which

l=length in m.m.

r=least radius of gyration in m.m.

Members which are connected at the ends by rivets shall be considered as having fixed ends and the length "l" shall be taken as the distance center to center of nearest rivets. Members connected by pins shall be considered as having hinged ends, the length being taken as the distance center to center of pins.

40. Max. $\frac{l}{r}$.—For any member or flange in compression subject to impact, the length divided by the least radius of gyration shall not exceed $\frac{200}{1+I}$ for moving live loads other than wind, in which I = impact coefficient as determined by preceding formula. For members subjected to wind strains only, the length divided by the least radius of gyration shall never exceed 175.

41. Tension Members.—Members in tension shall be proportioned so that the maximum strain shall not exceed 20,000 lbs. per sq. inch (1406 kg. per sq. c.m.) net section.

42. Bending.—The extreme fibre strain in members subject to bending shall not exceed:—

AMERICAN. In pounds per sq. inch.		METRIC. In kg. per sq. c.m.	
Pins (See table No. 45)	25,000	Pins (See table No. 45)	1,758
Rolled shapes	20,000	Rolled shapes	1,406
Cast steel	15,000	Cast steel	1,055

43. Shear.—The maximum shearing strain for web plates, net section shall not exceed:—

AMERICAN. (See table No. 46.)

In pounds per sq. inch.

$$15{,}000-100\frac{d}{t}$$

Where

d=unsupported distance in inches between chord angles or stiffeners.

t=thickness of web in inches.

METRIC. (See table No. 46.)

In kg. per sq. c.m.

$$1055-7.03\frac{d}{t}$$

Where

d=unsupported distance in m.m. between chord angles or stiffeners.

t=thickness of web in m.m.

The shearing strains on other parts of the structure shall not exceed;—

AMERICAN. In pounds per sq. in.		METRIC. In kg. per sq. c.m.	
Rolled Shapes	15,000	Rolled Shapes	1,055
Pins	15,000	Pins	1,055
Shop Rivets (See table No. 47)	12,000	Shop Rivets (See table No. 47)	844
Field Rivets (See table No. 47)	10,000	Field Rivets (See table No. 47)	703
Anchor Bolts	10,000	Anchor Bolts	703
Cast Steel	10,000	Cast Steel	703

44. Net Section.—For all members in which net section is required for tension, bending, shear, etc., full allowance must be made for reduction in area due to rivet holes, screw threads, etc. For all material 5/8 of an inch (16 m. m.) thick and under, the rivet holes shall be considered as 1/8 of an inch (3.2 m. m.) larger in diameter than the undriven rivet, and for material over 5/8 of an inch (16 m. m.) thick, 3/16 of an inch (4.8 m. m.) must be allowed. (See table No. 43 for deductive areas.)

45. Bearing.—The bearing strains for various parts shall not exceed.—

AMERICAN. In pounds per sq. inch.		METRIC. In kg. per sq. c.m.	
Pins (See table No. 45)	28,000	Pins (See table No. 45)	1,968
Shop Rivets (See table No. 47)	24,000	Shop Rivets (See table No. 47)	1,687
Field Rivets (See table No. 47)	20,000	Field Rivets (See table No. 47)	1,406
Cast Steel	20,000	Cast Steel	1,406
Bronze discs	6,000	Bronz discs	422
Masonry	500	Masonry	35
Hard Wood across the grain	350	Hard Wood across the grain	25
Hard Wood with the grain	1,000	Hard Wood with the grain	70
Expansion rollers 1,200*r* per lin. inch, where *r*=radius of rollers or curvature of bolster in inches.		Expansion rollers 84*r* per lin. c.m., where *r*=radius of rollers or curvature of bolster in c.m.	

46. Plate Girders.—In proportioning plate girders, 1/8 of the web may be considered as flange area.

The effective depth of all girders shall be taken as the distance center to center of gravity of the chords.

Where it is necessary to use flange plates to make up the required sectional area, such flange plates shall not exceed ½ of the total flange area unless the largest size angles obtainable are used.

The compression flange shall have the same gross sectional area as the tension flange.

47. Cover Plates.—The distance from the edge of the flange plates of girders or cover plates of chords or posts, to the center of the outer rivets connecting them to the member must not exceed 5 inches (127 m. m.) nor eight times the thickness of the first plate, nor shall the thickness of any cover plate be less than $^1/_{20}$ the distance center to center of rivets measured in line of strain, nor less than $^1/_{40}$ the distance center to center of rivets measured at right angles to line of strain. Where rivets in cover plates transmit horizontal shear as in the case of girders, the maximum thickness to be gripped must not exceed four times the diameter of the rivets, and in no case shall the thickness of material to be gripped exceed six times the diameter of the rivets.

48. Rolled Beams.—Rolled Beams shall be proportioned by their moments of inertia.

49. Depth of Girders.—Riveted longitudinal girders shall generally be made with a depth of not less than $^1/_{10}$ of the span.

Rolled Beams if used as longitudinal girders shall generally be made with a depth of not less than $^1/_{12}$ of the span.

In case it is necessary to use shallower depths, the girders and beams must be so designed that the maximum deflection will not exceed that of girders and beams designed for above depths.

50. Bracing.—For deck bridges, top and bottom laterals will be used with sway bracing at each panel point, the wind stresses from the moving load and all centrifugal forces being resisted entirely by the top lateral system.

In quarter through bridges each panel point must have sufficient transverse bracing to transmit the wind and centrifugal stresses to the bottom chord without producing any bending in the truss posts,

and the bottom chord laterals must be sufficient to transmit the entire wind and centrifugal stresses from the structure and train to the abutments.

In half through bridges the entire wind and centrifugal stresses shall be resisted by a system of lateral bracing placed at the bottom chord level.

In through bridges the wind stresses due to the train and all centrifugal stresses shall be resisted by the bottom lateral system. All through spans shall have riveted portals, rigidly connected to the end posts and top chords, and of as great a depth as the headroom will permit. The portals are to be proportioned so as to properly transmit the wind stresses from the top lateral bracing to the end posts, which posts are to be properly proportioned to resist these stresses.

When a floor system of cross beams and stringers is used for any of the above types of bridges, sufficient lateral bracing must be provided between the stringers and so placed that the limiting conditions given in paragraph 40 are not exceeded.

51. Stiff Members.—The first hanger and first two panels in the bottom chord of trussed bridges shall be stiff members, capable of resisting either tension or compression.

52. Minimum Thickness.—No material except for filling, packing, facia plates, etc., less than 5/16 inches (8 m. m.) thick shall be used for main members and their connections, nor for laterals carrying centrifugal stresses. For wind or stiffening bracing no material less than ¼ inch (6.4 m. m.) thick shall be used.

53. End Cross Girders.—Only on Bridges when the track is on a curve will end cross girders be provided, in all other cases the ends of the stringer beams will rest on the masonry and be properly braced to the trusses.

DETAILS OF CONSTRUCTION.

54. Camber.—All trussed bridges shall have a camber which shall be computed from the total dead and live loads and shall be such that the structure will not deflect below an approximately horizontal line under the full loading.

55. Details.—The details of the several parts and all connections of the different members throughout the structure will be so proportioned that rupture will occur in the body of the member rather than in connections upon testing the full size members, and all details shall be arranged, as far as possible, to give access for inspection and painting of same.

56. Riveting.—The maximum pitch of rivets and bolts shall rarely exceed 6 inches (152 m. m.) or twenty times the thinnest outside plate, and three diameters will be the minimum pitch except for special details. The rivets and bolts used shall be 5/8, 3/4, 7/8 and 1 inch (16 m. m., 19 m. m., 22 m. m. and 25.4 m. m.) diameter.

The distance from the center of the hole to the edge of any piece will not be less than 1 1/4 inches (32 m. m.), except for bars less than 2 1/2 inches (64 m. m) wide and in special details.

Angles subject to direct tension must be connected by both legs or the section of the connected leg only will be considered as effective.

Compression members shall have the rivets at the ends spaced not over four diameters apart for a length of 1 1/2 times the width of the member.

The effective diameter of a driven rivet shall be assumed the same as its diameter before driving. No metal shall be thicker than the diameter of the rivet except in rolled beam flanges. Rivets shall never be used in direct tension.

In heavy continuous compression members, such as chords and trestle posts, the abutting joints will be planed and the joint will be placed close to the panel point. The joint will be spliced on all sides with at least two rows of rivets or bolts on each side of the joint.

In light compression members abutting joints with untooled faces will be fully spliced with rivets or bolts, and no reliance will be placed on the bearing of the untooled faces.

All joints in riveted tension members must be fully and symmetrically spliced.

The webs of plate girders must be fully spliced at all joints by a splice plate on each side of the web, not less than $^5/_{16}$ of an inch (8 m. m.) thick and with a sufficient number of rivets on each side of the joint to properly resist the shear at the point of splice.

57. Stiffeners.—All web plates in riveted girders shall have stiffeners over bearings and at points of concentrated loadings and at such distances apart as the thickness of web plate may require, those at the bearing points to be of neat length and fitted to the flange angles.

58. Elevation of Rails.—For bridges on a curve, the floor system will be constructed horizontal and the elevation of the outer rail will be effected by wedging or blocking pieces, or notching the ties.

59. Tie Plates.—The open sides of all compression members shall have tie plates placed as near the ends as possible. Such tie plates must have a length not less than the greatest width of the member and a thickness of at least $^1/_{50}$ the distance between the rivets connecting them to the members.

60. Lattice Bars.—Single lattice bars shall have a thickness of not less than $^1/_{50}$ and double lattice bars not less than $^1/_{60}$ of the distance between rivets connecting them to the members, or when the lattice bars are held between double members as in the case of 4 angle latticed I struts, of the unsupported distance between such double members.

The widths of the lattice bars shall not be less than 2 inches (51 m. m.) for members 9 inches (229 m. m.) or less in width nor $2\frac{1}{4}$ inches (57 m. m.) for members 9 to 12 inches (229 to 305 m. m.) in width, nor $2\frac{1}{2}$ inches (64 m. m.) for members 12 to 15 inches (305 to 381 m. m.) in width. Where double lacing is used the bars must be riveted together at the intersections with each other.

61. Turnbuckles.—Open sleeve nuts or turnbuckles must always be used for adjustable members, and they must be either locked or jamb nutted so as to prevent them working loose. Closed sleeve nuts will not be permitted.

62. Nuts.—All bolts shall be provided with double nuts or else provision must be made for locking to prevent them working loose. Anchorage bolts will always be double nutted.

63. Sliding Bearings.—For all spans 75 ft. (23 M.) and under, one end of the bridge shall be firmly anchored to the masonry and the other end shall be arranged with a sliding bearing consisting of a bottom plate anchored to the masonry and an upper plate riveted to the structure.

The upper plate to have slotted anchor bolt holes of sufficient length to allow the expansion and contraction of the girders. The sliding surfaces in contact to be planed or faced smooth.

64. Roller Bearings.—For all spans from 75 ft. to 100 ft. (23 M. to 30.5 M.) bearings similar to the above shall be provided except that a nest of turned rollers shall be placed between the faced plates, the rollers to be provided with proper spiders to keep the rollers always in true line. For spans over 100 ft. (30.5 M.), pin connected shoes or bolsters shall be provided at each end. On one end the shoes will rest directly on the masonry and be anchored to same. On the other end the shoes will rest on a nest of turned rollers running between planed surfaces.

65. Temperature.—Provision shall be made for an expansion and contraction due to variation in temperature of 50 degrees centigrade.

66. Anchorage.—Proper anchorage shall be provided at all bearings on masonry, provision being made for uplifting due to wind pressure and to shear from wind, traction and centrifugal force.

67. Pin Plates.—Where pin holes occur in riveted members the same shall be re-enforced by pin plates when necessary and must be so arranged that the pressure on the pins will be properly distributed over the full cross section of the members. Enough rivets must be provided so that each individual plate will be capable of transferring its portion of the pressure from the pin to the section of the main member.

68. Eye Bars and Pins.—The heads of eye bars shall be so proportioned and made that the bars will break in the body of the original bar rather than at any part of the head or neck.

The diameter of the pin shall preferably be not less than three-quarters of the width of the largest bar attached to it, and all pin connected joints shall be closely packed so as to produce as little bending on the pin as possible.

WORKMANSHIP.

69. Built Up Members.—All parts will be assembled in the shops during the fabrication and the pieces forming the shafts of the main members riveted or bolted up, after which all large gusset plates and projecting parts will be taken off to accommodate the shipment of the material by steamer or by railroad, or the holes for field connections except those for laterals and sway bracing may be reamed to an iron template.

All members must be free from twists and bends and the several pieces composing the member must fit closely together. Portions exposed to view will be neatly finished.

70. Riveting.—All rivets when driven must completely fill the holes and have round concentric heads of uniform size, thoroughly pinching the connected pieces together.

For punching, the diameter of the punch shall not exceed the diameter of the bolt or the rivet to be used by more than $^1/_{16}$ of an inch (1.6 m. m.), and after the work is assembled a reamer shall be put through each hole, if necessary, to correct the slight variations of the punchings so that a cold rivet may be inserted without drifting.

All holes in medium steel which is over $^5/_8$ of an inch (16 m. m.) thick, shall be drilled or reamed $^1/_8$ of an inch (3.2 m. m.) larger in diameter than the punched holes, so as to remove all sheared or burred edges.

Wherever possible all rivets will be machine driven by direct acting machines, operated by compressed air, steam or hydraulic pressure. In cases where this is impossible pneumatic hammers shall be used wherever practical.

71. Eye Bars.—The heads of eye bars shall be made by rolling, upsetting, or forging into shape. Welds in the body of the bar are debarred, eye bars must be free from flaws and shall be carefully annealed. Eye bars must be perfectly straight before boring, and pin holes must be in center of heads and on the axes of the bars.

Bars of the same class and belonging to the same panel shall be bored at the same temperature and the lengths must not vary more than $^1/_{32}$ of an inch (0.8 m. m.) for each 30 ft. (9.1 M.) of total length, and bars which are to be placed side by side in the structure shall, if piled on each other, allow the pins to pass through at both ends without driving,

The diameter of the hole shall not exceed the diameter of the pin more than $^1/_{32}$ of an inch (0.8 m. m.).

72. Adjustable Members.—Tie rods or counters shall be fabricated with the same care and precision as is prescribed for the bars.

Screw ends shall be upset so as to insure that the attached members will break in the body of the bar.

Sleeve nuts, clevices, etc., used for adjustment, will be of sufficient strength to break the bar to which they are attached.

73. Pilot Nuts.—Pilot nuts must be used during the erection to protect the threads of the pins.

74. Sheared Edges.—All sheared edges in medium steel over $^5/_8$ of an inch (16 m. m.) thick shall be planed and all edges exposed in the finished piece that are rough or burred must be properly dressed, either by grinding or otherwise.

75. Floor Beams and Stringers.—Floor beams and stringers framing in between posts or floor beams to be faced off true and square to the correct lengths.

76. Abutting Surfaces.—All abutting surfaces in heavy compression members shall be truly faced to a bearing.

77. General.—All workmanship shall be first class in every particular.

78. Painting.—All metal work before leaving the shop shall be thoroughly cleaned from all loose scale and rust and given one good coat of pure linseed oil, well worked into all joints and open spaces.

In riveted work, the surfaces coming in contact shall each be painted before being riveted together, and all parts of the structure which will be difficult of access after assembling shall receive two coats of paint before being assembled.

Pins, bored pin holes and turned friction rollers and all planed surfaces shall be coated with white lead and tallow immediately after facing and before being shipped from the shop.

Painting of the completed structure after erection is not included in this specification.

79. Inspection.—All facilities for the inspection of material and workmanship will be permitted to the owner or his representatives, without additional charge, but such inspection must, for the raw material, be performed at the rolling mills or foundries where the rolled steel or the castings are manufactured, and the inspection for workmanship must be performed at the shops before the material is shipped, and such inspection and acceptance must be final at these points.

80. Draw Bridges, Etc.—Draw bridges, turn-tables, high trestle towers, etc., will be considered as special structures but will be designed on the same general lines and using the same unit stresses, loadings, quality of material and other limiting conditions as given in the foregoing specification.

STANDARD SPECIFICATION FOR HIGHWAY BRIDGES.

GENERAL DATA REQUIRED.

1. **General.**—In order to make a correct design the same general data should be furnished as noted in Railway Bridge Specifications, such as the heaviest load which will pass over the bridge, the clear span, various heights from high water, the skew angles, widths of intermediate piers, clearances required, etc., etc. It will also be necessary to know the clear width of roadway and whether sidewalks for pedestrians are to be provided for. The uses for which the bridge is intended should also be specified, stating whether it is to be located in a city which would require heavy traffic and electric cars, or whether it is to be located in the country and subject to only the conditions of ordinary light highway traffic. The general construction of the floor should be specified, that is whether it is to be a concrete or a plank floor.

In the absence of information to the contrary the bridge will be assumed as being in the country and having a plank floor.

TYPE OF BRIDGE.

2. Unless otherwise specified the type of the bridge generally adopted will be as specified for single track railway bridges, except that rolled beams may be used for spans up to 50 ft. (15.25 M.)

LOADINGS.

The various parts of the structure will be proportioned for the following loads, using the following combinations of loadings, DEAD + LIVE + LIVE IMPACT + WIND.

3. Dead Loads.—The dead load shall consist of the actual weight of all metal in the structure, plus the weight of all materials used in the flooring. Unless otherwise specified the weight of the floor construction in bridges having concrete floors shall be taken at 100 lbs. per sq. ft. (488 kg. per sq. M.) and for bridges having plank floors, the weight shall be taken at 20 lbs. per sq. ft. (98 kg. per sq. M.)

4. Live Loads.—Unless otherwise specified, double track city bridges will be proportioned to carry a 12 ton (24,000 lbs.) road roller on any part of the roadway and electric cars 30 ft. (9.15 M.) center to center on each track, tracks to be 10 ft. (3.05 M.) center to center transversely. Single track bridges will be proportioned to carry electric cars 30 ft. (9.15 M.) center to center as above and a road roller at any point on the bridge.

The roller shall be distributed as follows: 6 tons on the front axle and 6 tons on the rear axle, the axles being 10 ft. (3.05 M) center to center; one roller on the front axle 3 ft. (.92 M.) wide and two rollers on the rear axle, each 1 ft. 6 in. (.46 M.) wide and 4 ft. (1.22 M.) center to center transversely. An electric car shall be considered as weighing 18 tons (36,000 lbs.) distributed equally over 4 points, spaced 10 ft. (3.05 M.) centers longitudinally and 4.7 ft. (1.43 M.) transversely and occupying a floor space 8 ft. x 30 ft. (2.4 M. x 9.15 M.). In addition to either of the above loadings, the structure will be proportioned to carry a uniformly distributed live load of 100 lbs. per sq. ft. (488 kg. per sq. M.) over the entire remaining surface.

Country bridges will, unless otherwise specified, be proportioned to carry a 5 ton (10,000 lbs.) road

roller, the load being equally distributed over 2 axles 6 ft. (1.83 M.) centers, assumed as 3 ft. (.92 M.) wide, and in addition a uniformly distributed live load of 75 lbs. per sq. ft. (366 kg. per sq. M.) over the entire remaining surface.

5. **Impact.**—For city bridges the impact coefficient shall be taken as $\frac{1}{2}$ and for country bridges $\frac{1}{3}$ of that specified for railway bridges.

6. **Wind Pressure.**—Wind pressure shall be taken the same as specified for railway bridges except that no wind impact need be considered.

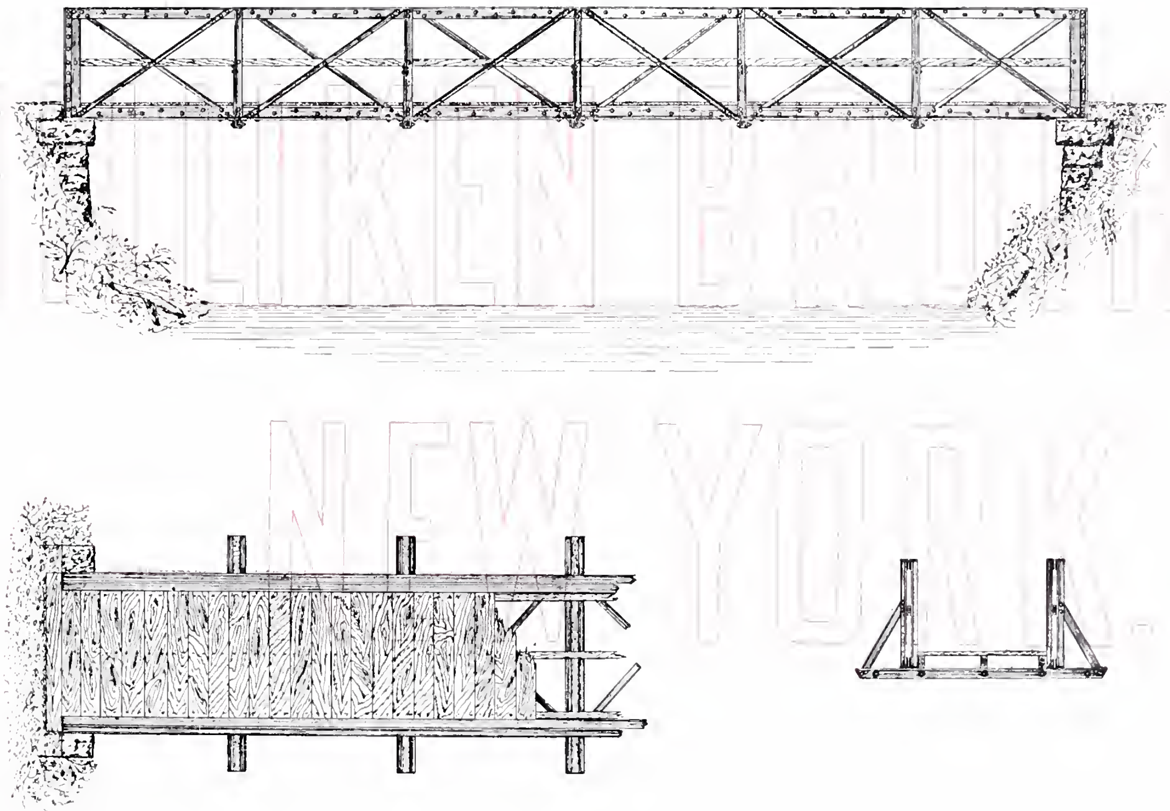
7. **Quality of Material, etc.**—Quality of material, tests, etc. and all items under headings "Proportioning Sections," "Details of Construction," "Workmanship," and "Inspection," shall be as specified for railway bridges, with the following exceptions; the depth of longitudinal riveted girders shall generally be $^1/_{16}$ of the span for bridges having concrete floors and $^1/_{24}$ of the span for bridges having plank floors. The depth of rolled beams when used as longitudinal girders shall generally be $^1/_{24}$ of the span for bridges having concrete floors and $^1/_{36}$ of the span for bridges having plank floors.

The minimum thickness for metal in any part of the structure except filling pieces, etc. shall be $\frac{1}{4}$ inch (6.4 m.m.).

The holes for field connections need not be reamed to an iron template but must fit as accurately as practicable.

8. **Railings.**—A strong and substantial hand railing shall be provided for each side of the bridge, well secured to the superstructure.

Plate No. 68.



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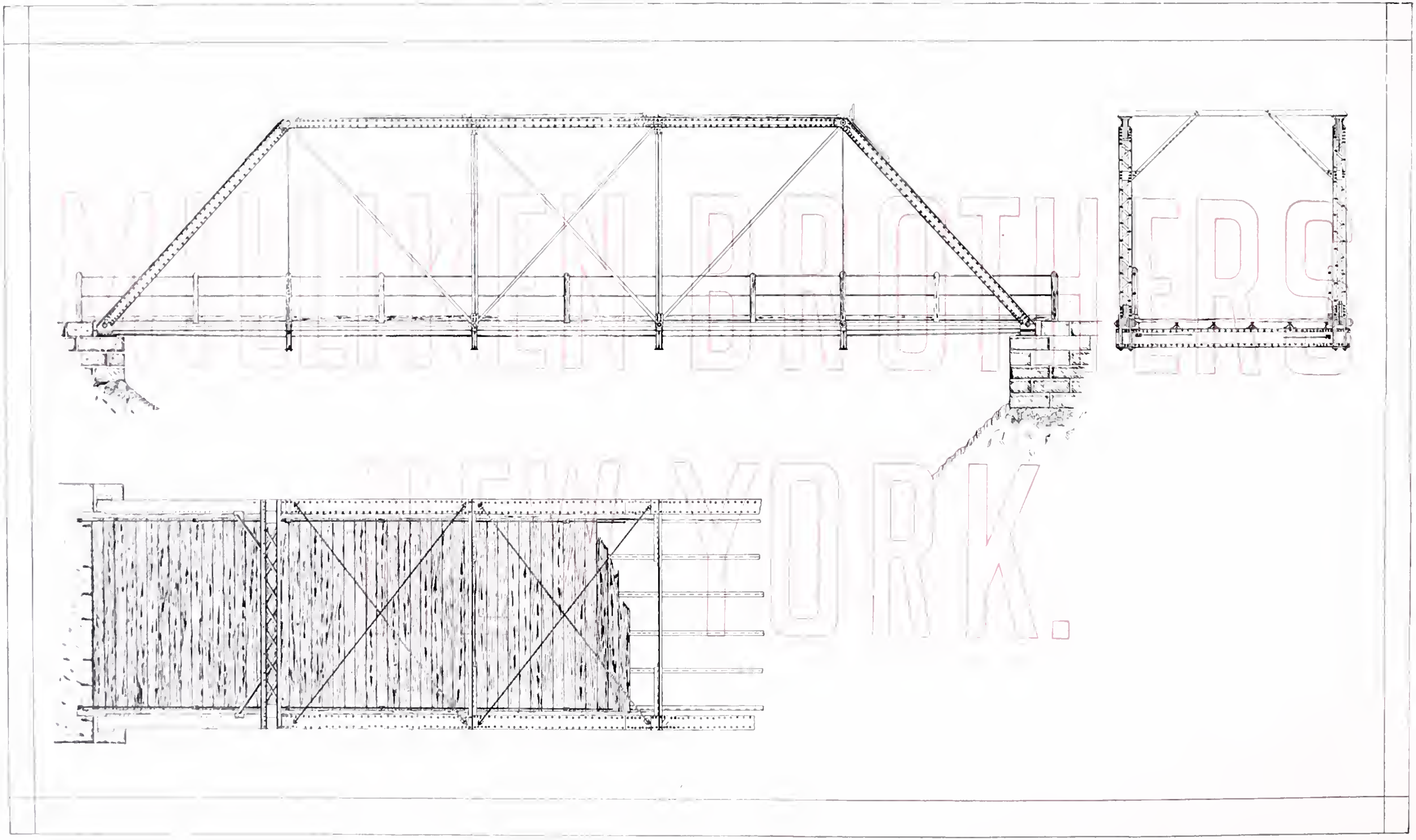

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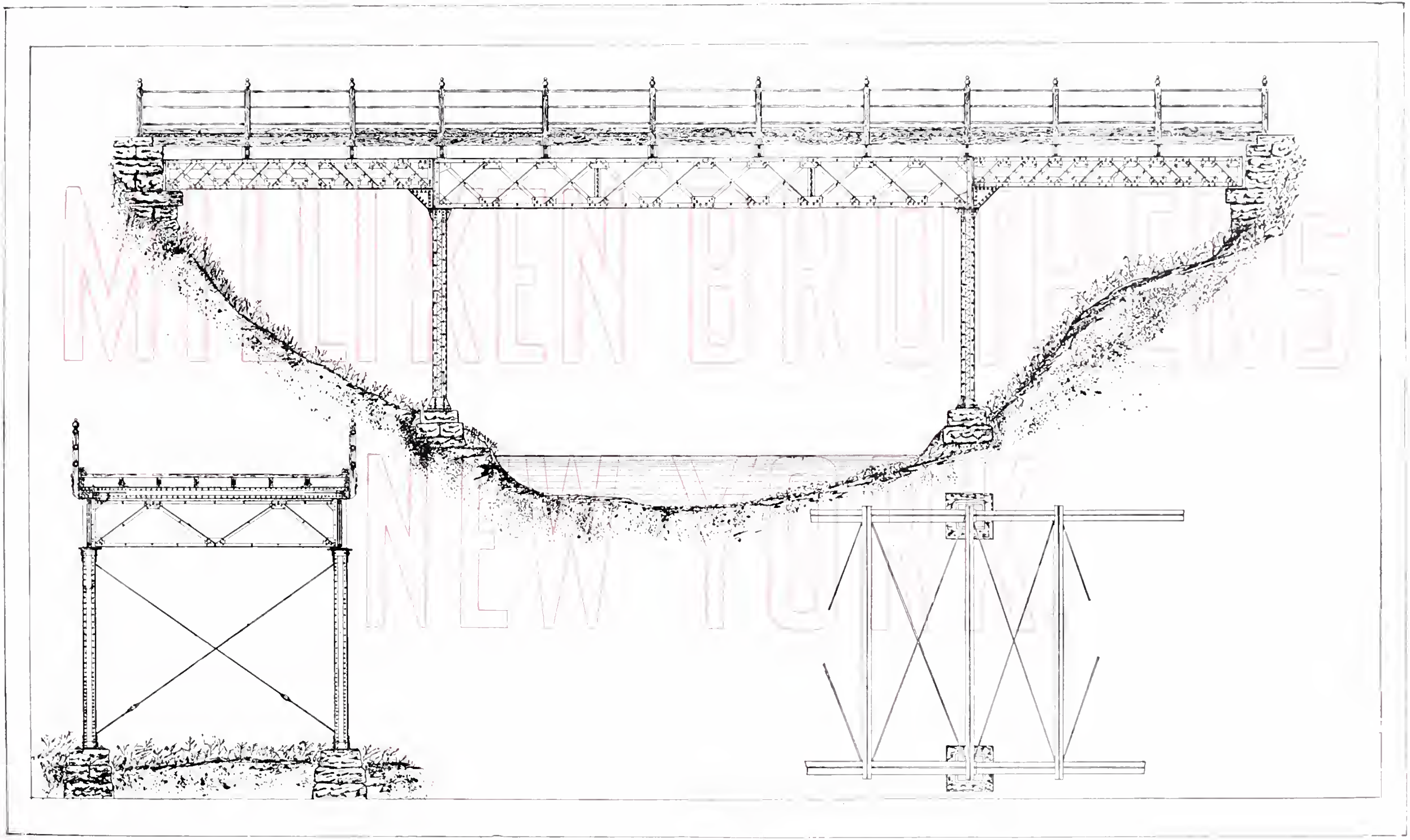

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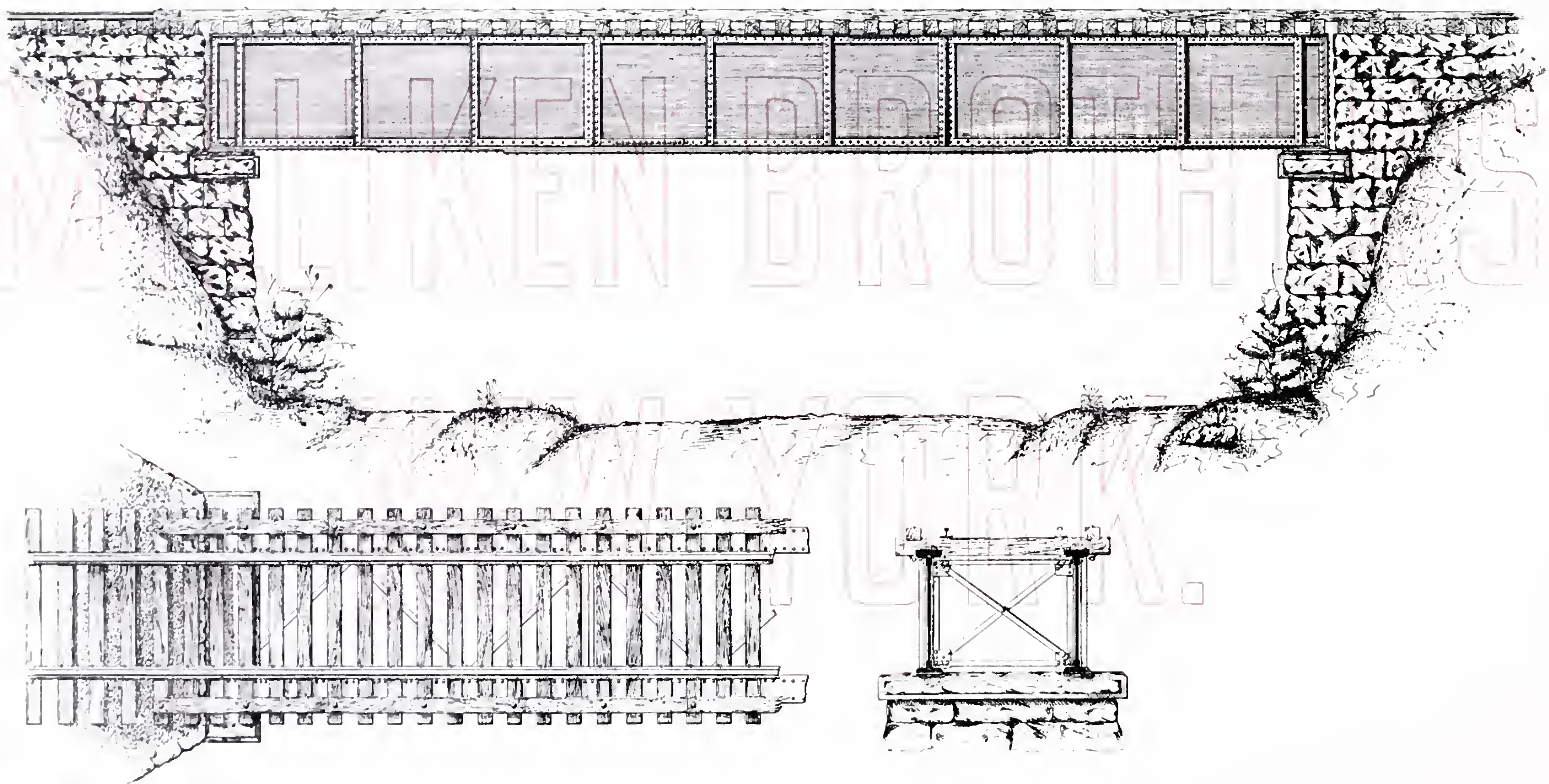

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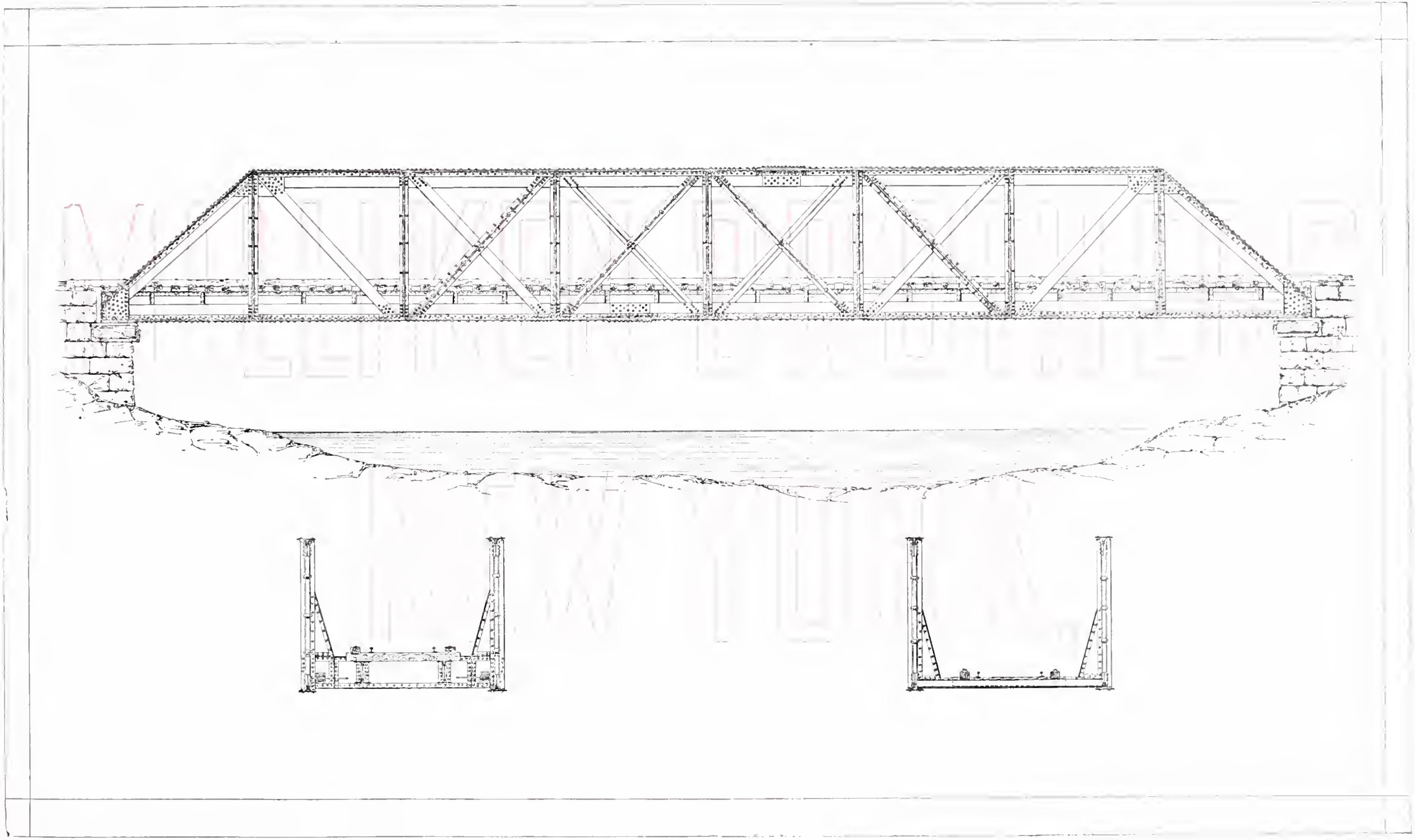

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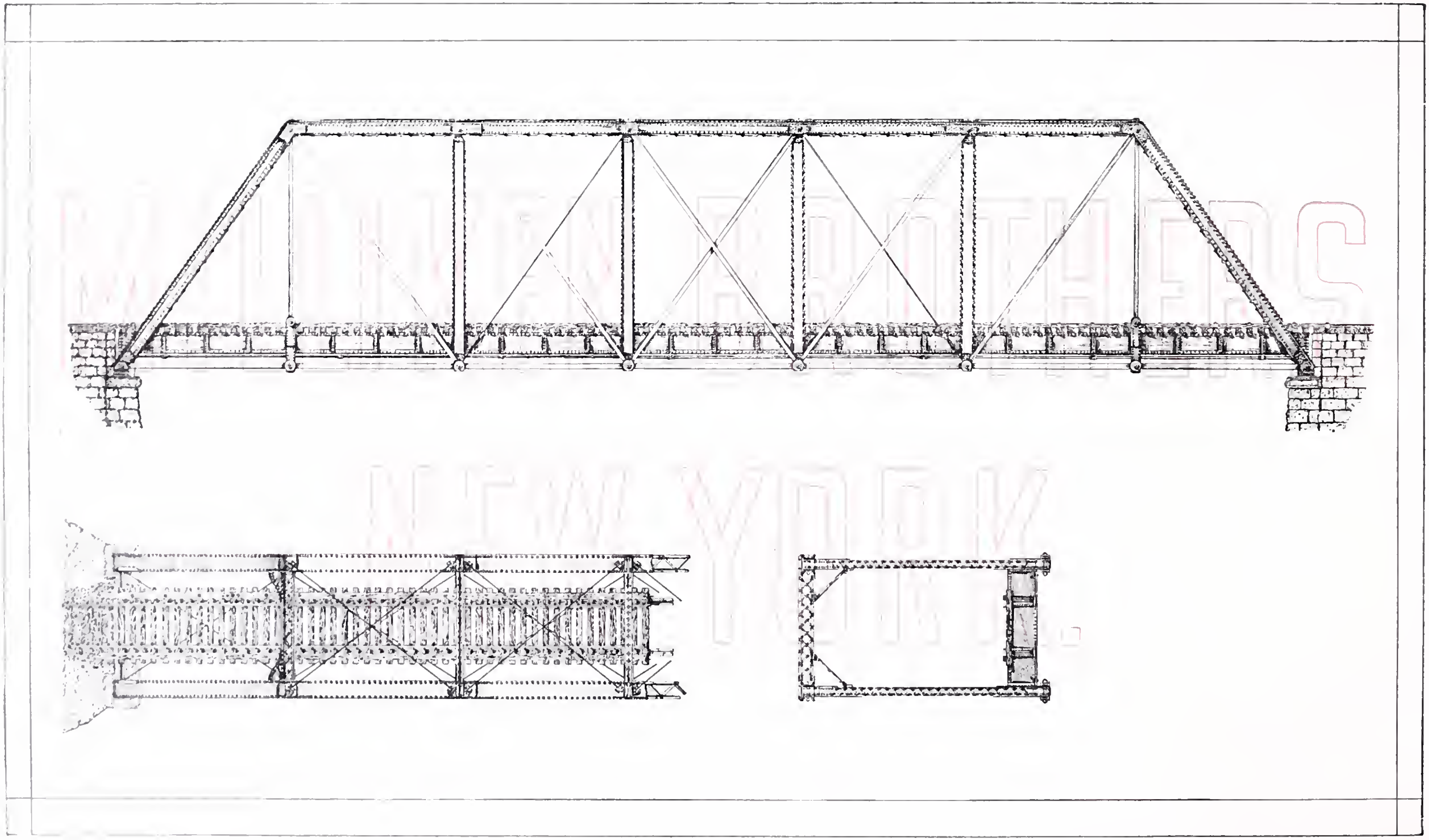

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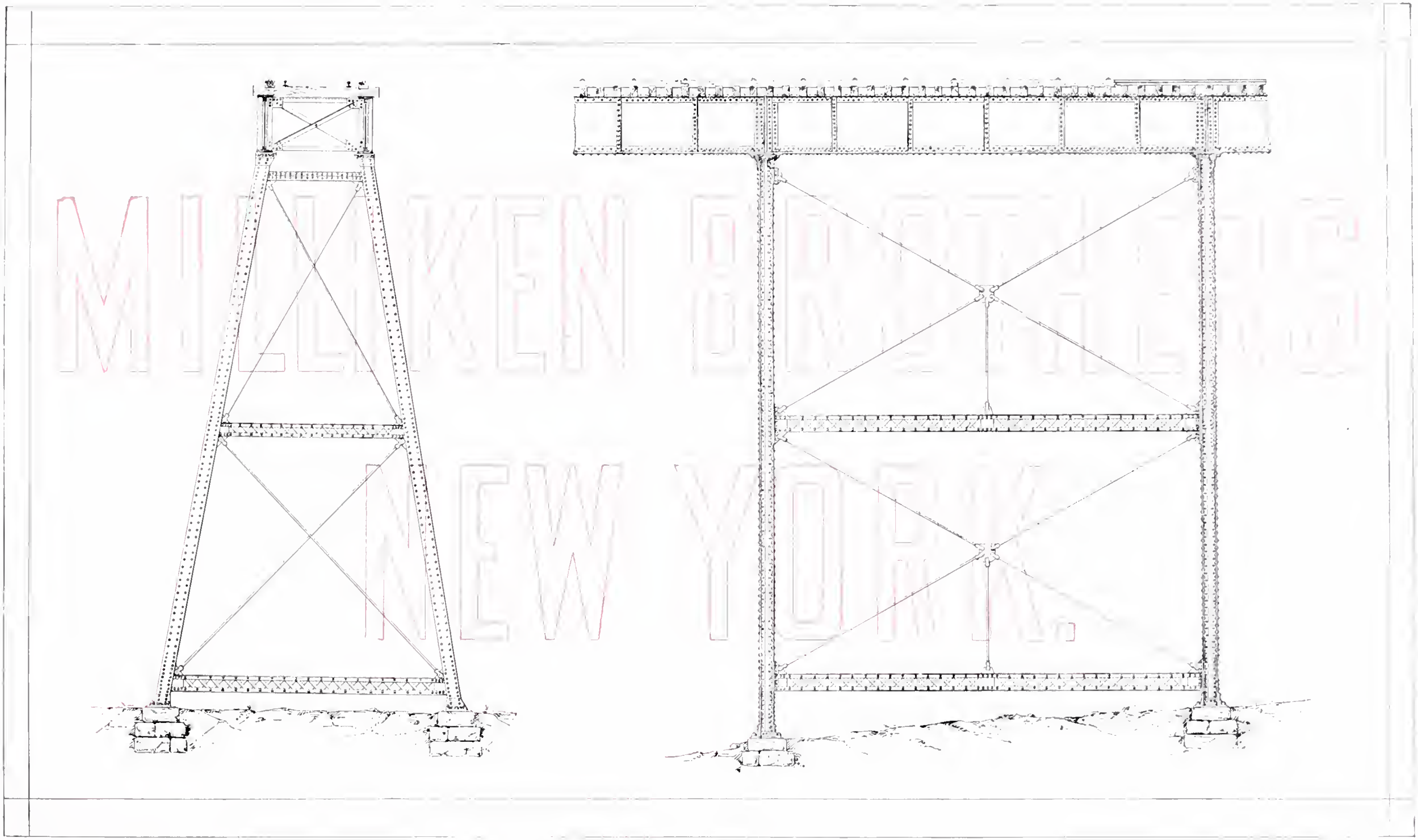


Overhead Foot Bridge Crossing Tracks of Central R. R. of N. J.

STEEL WORK DESIGNED, FURNISHED AND ERECTED BY MILLIKEN BROTHERS.

Overhead Highway Bridge Crossing Tracks of Central R. R. of N. J.

STEEL WORK DESIGNED, FURNISHED AND ERECTED BY MILLIKEN BROTHERS.

HIGHWAY PLATE GIRDER BRIDGE, PROVIDENCE, R. I.

DESIGNED, FURNISHED AND ERECTED BY MILLIKEN BROTHERS.

HIGHWAY PONY TRUSS BRIDGE, PLAINFIELD, N. J.

DESIGNED, FURNISHED AND ERECTED BY MILLIKEN BROTHERS.

HIGHWAY TRUSS BRIDGE, THREE BRIDGES, N. J.

DESIGNED, FURNISHED AND ERECTED BY MILLIKEN BROTHERS.

Stockton Street Crossing, Central Railroad of N. J., Phillipsburg, N. J.

DESIGNED, FURNISHED AND ERECTED BY MILLIKEN BROTHERS.

90 Ft. Plate Girder Span for Plant System of Railways.

STEEL WORK DESIGNED, FURNISHED AND ERECTED BY MILLIKEN BROTHERS.

90 FT. PLATE GIRDER SPAN FOR PLANT SYSTEM OF RAILWAYS.

STEEL WORK DESIGNED, FURNISHED AND ERECTED BY MILLIKEN BROTHERS.

150 Ft. Deck Riveted Truss R. R. Bridge with Plate Girder Approaches for Choctaw, Okla. & Gulf Railroad.

Steel Work Designed, Furnished and Erected by Milliken Brothers.

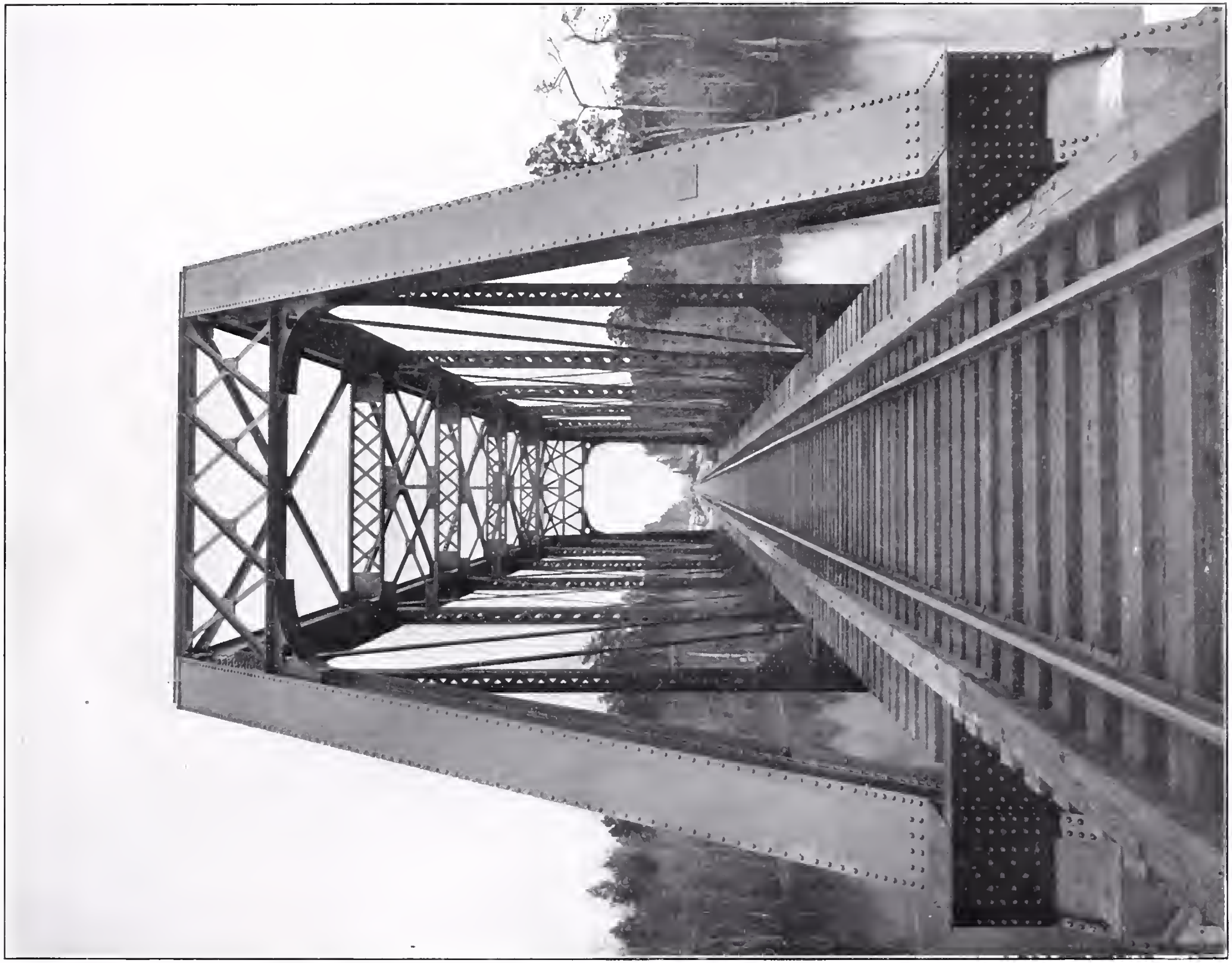
150 Ft. Pin Connected Deck Railway Bridge with Trestle Bent Approaches for Cuba Co., Cuba.

STEEL WORK DESIGNED AND FURNISHED BY MILLIKEN BROTHERS.

110 Ft. Pony Truss Riveted R. R. Bridge for N. J. Terminal R. R. Co., Rahway, N. J.

STEEL WORK DESIGNED, FURNISHED AND ERECTED BY MILLIKEN BROTHERS.

175 Ft. Through Riveted Truss Railroad Bridge for Plant System of Railways.



STEEL WORK DESIGNED, FURNISHED AND ERECTED BY MILLIKEN BROTHERS.

250 Ft. Camel-Back Pin Connected Railroad Bridge for Choctaw, Oklahoma & Gulf R. R.

STEEL WORK DESIGNED, FURNISHED AND ERECTED BY MILLIKEN BROTHERS.

250 Ft. Camel-Back Pin Connected Railroad Bridge for Choctaw, Oklahoma & Gulf R. R.

STEEL WORK DESIGNED, FURNISHED AND ERECTED BY MILLIKEN BROTHERS.

685 Ft. Bridge Crossing Rio Grande in Costa Rica. Centre Arch 450 Ft.

STEEL WORK DESIGNED AND FURNISHED BY MILLIKEN BROTHERS.

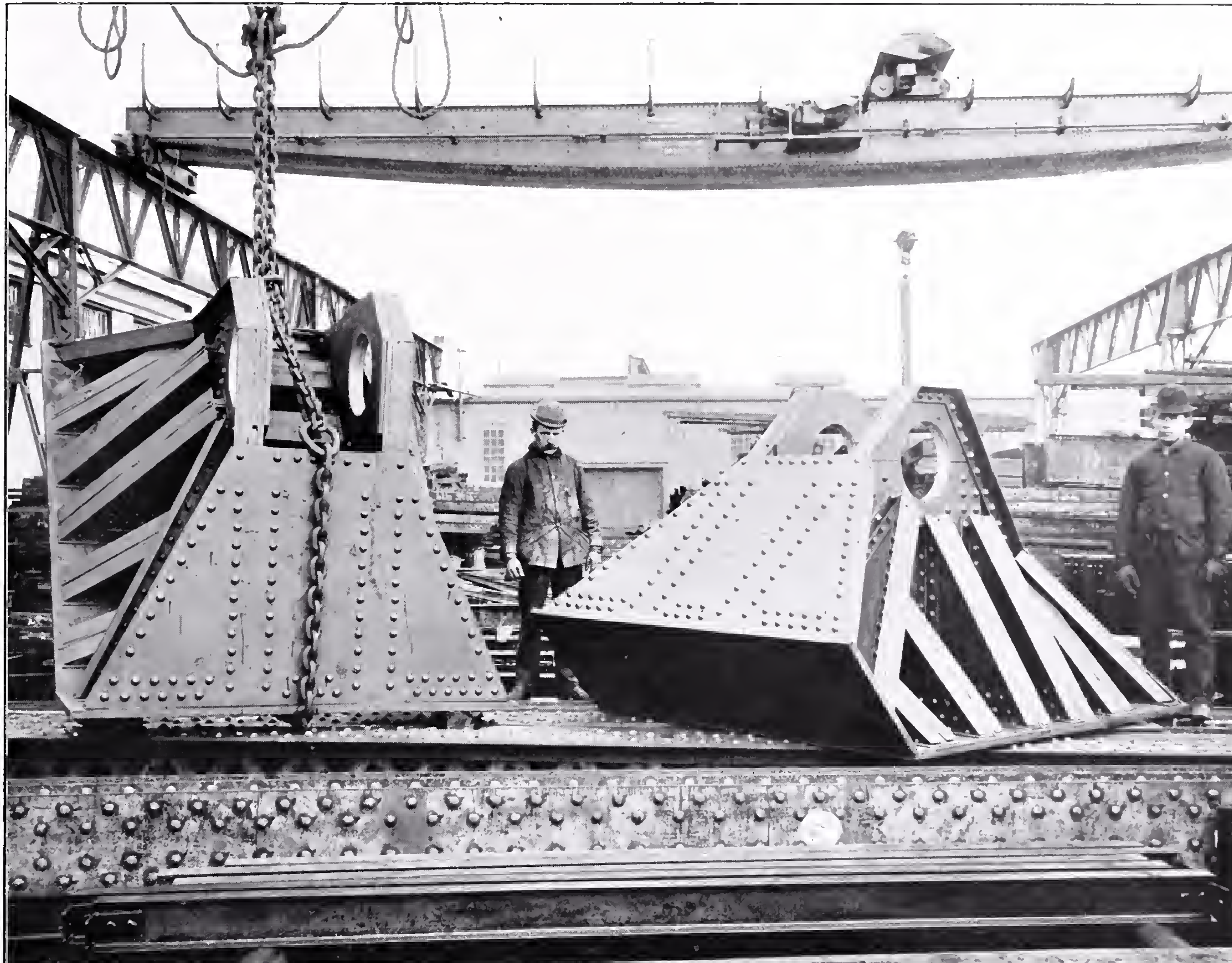
685 Ft. Bridge Crossing Rio Grande in Costa Rica. Centre Arch 450 Ft.

STEEL WORK DESIGNED AND FURNISHED BY MILLIKEN BROTHERS.

685 Ft. Bridge Crossing Rio Grande in Costa Rica. Centre Arch 450 Ft.

STEEL WORK DESIGNED AND FURNISHED BY MILLIKEN BROTHERS.

Shoes or Pedestal Blocks Ready for Shipment. Costa Rica Arch Bridge.



STEEL WORK DESIGNED AND FURNISHED BY MILLIKEN BROTHERS.

685 Ft. Bridge Crossing Rio Grande in Costa Rica. Centre Arch 450 Ft.

STEEL WORK FURNISHED AND ERECTED BY MILLIKEN BROTHERS.

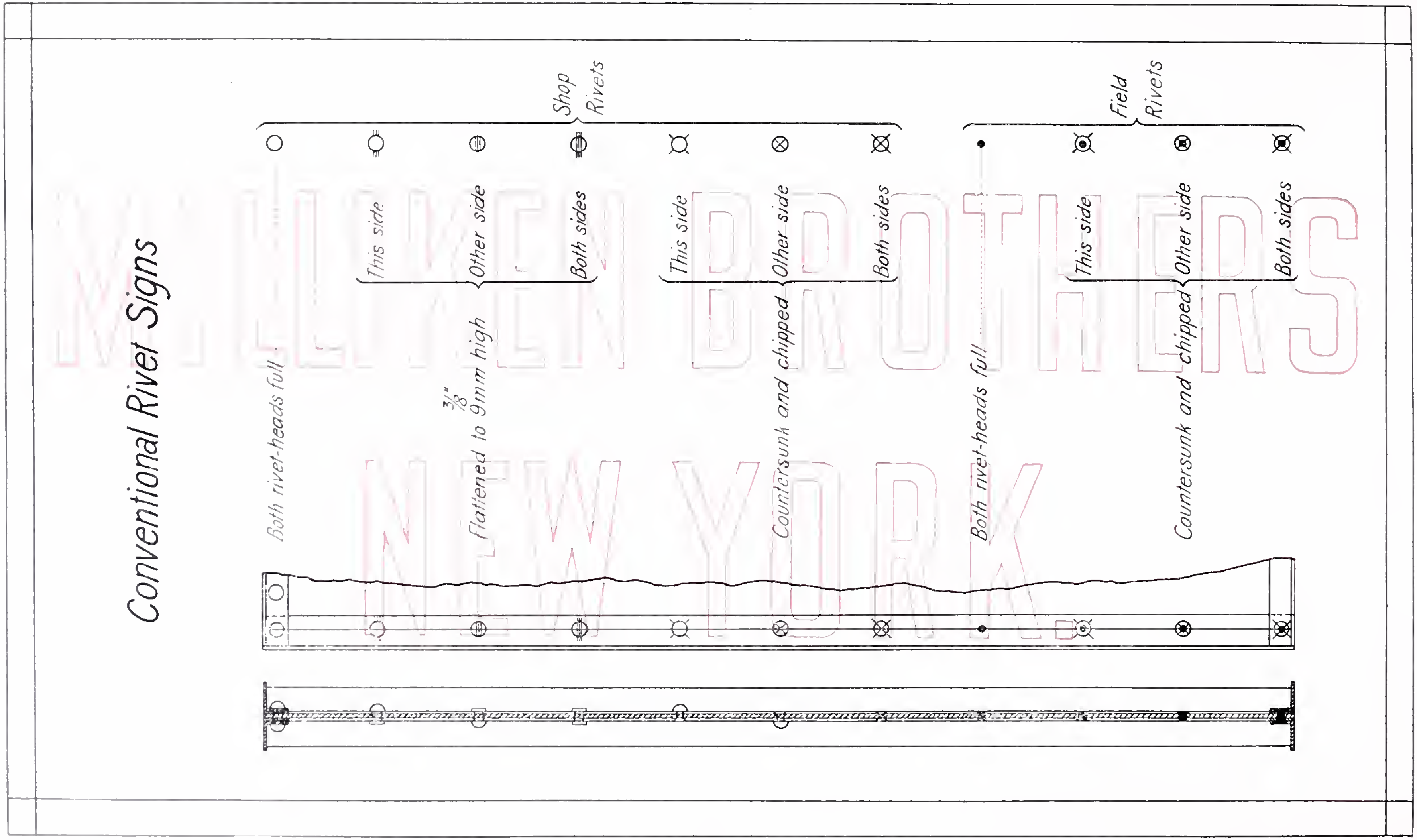
DRAWINGS.

With each shipment of goods, where the owners attend to the erection, we make a specialty of furnishing complete detailed drawings showing the marks and location of the pieces, so that it is impossible to make any mistake in assembling or putting together the members. Also a complete list of all the bolts, rivets and other fittings. In order to intelligently understand the signs or symbols used on said drawings, we refer our customers to Plate No. 75, which gives the symbol for rivets and a sketch showing the meaning of these symbols. In the case of bolts, rivets and small pieces, we invariably send an excess quantity to provide against accidental losses in erection.

Where parties so order it, we send a complete list and furnish the tools necessary for erecting purposes, such as hammers, chisels, rivet forges, and in many cases, steam hoisting engines.

In the case of sheet iron work, we send complete plans showing the marks and location of the sheets, gutters, casings, flashing, etc., and a full and complete specification, and instructions as to how the parts are to be constructed, and in cases where the owners order it, we send the special tools necessary to put this work up. We always send a certain percentage in excess of the actual number of the small pieces required for connecting the sheet metal work, for the reasons given above.

In cases where parties order it, we are in a position to send out capable erectors on all classes of work, and superintendents to take charge of the erection of buildings, bridges, etc.


Conventional Rivet Signs
Shop Rivets
Field Rivets
Both rivet-heads full
This side
Other side
Both sides
Flattened to 3/8" 9mm high
This side
Other side
Both sides
Countersunk and chipped
Both rivet-heads full
This side
Other side
Both sides
Countersunk and chipped

ORNAMENTAL CAST IRON COLUMNS FOR BUILDINGS.

We furnish ornamental cast iron columns for buildings. These columns can be either round or square, with plain or fluted shafts, and can be made with caps of Corinthian, Ionic, Romanesque, Gothic or of plain moulded design with bases to correspond. See Plate No. 76. Caps and bases of any special design can be made to order. These columns can be made of sufficient thickness to carry the weight of the building and thus take the place of plain supporting columns; or we can furnish them simply as shells, made in halves, to be placed around the structural or supporting columns. See column on page 398 with Corinthian cap, base and band. These columns support the floor of a store building and are placed in rows, giving a highly ornamental effect. The two columns shown on page 357, one at each side of the main entrance, are made of solid bronze, and are built up in sections as shells, encasing the supporting columns. These bronze columns give a very rich finish to the front of the building.

Plate No. 76.

ILLUMINATING PATENT LIGHTS FOR SIDEWALKS.

On Plate No. 77 we show designs of different kinds of Patent Illuminating Lights for sidewalks, to light basements or areas underneath same. The design at the extreme left hand side of plate is the "Knob Protected Light," where the glass is protected by cast iron knobs. This pattern is very much used for warehouse work or in front of shipping entrances. The knobs protect the glass from being broken by heavy cases or boxes while being moved over the sidewalk. The glass can be furnished of either 1½ inch or 3 inch diameter; the larger size gives more light, but it will not carry as great a load as the smaller light on account of the cast iron ribs around the glass being farther apart.

The next design is in round glass laid in cement, either with or without brass rings. The rings add to the expense but make the lights more durable. These cement lights are well adapted for the front of office buildings, stores or for any ordinary sidewalk traffic, and present a very clean and neat appearance. The centre portion of the cut represents two styles of square light, either 3 inch or 4 inch glass which can be used for sidewalks, for skylights in the roof, for floor lights, throwing the light from one floor down to the floor below, or for vertical lights in the sides of areas. At the right hand of cut we show a pair of doors in the sidewalk made with a heavy steel plate and with 1½ inch round glass set in brass rings. Doors

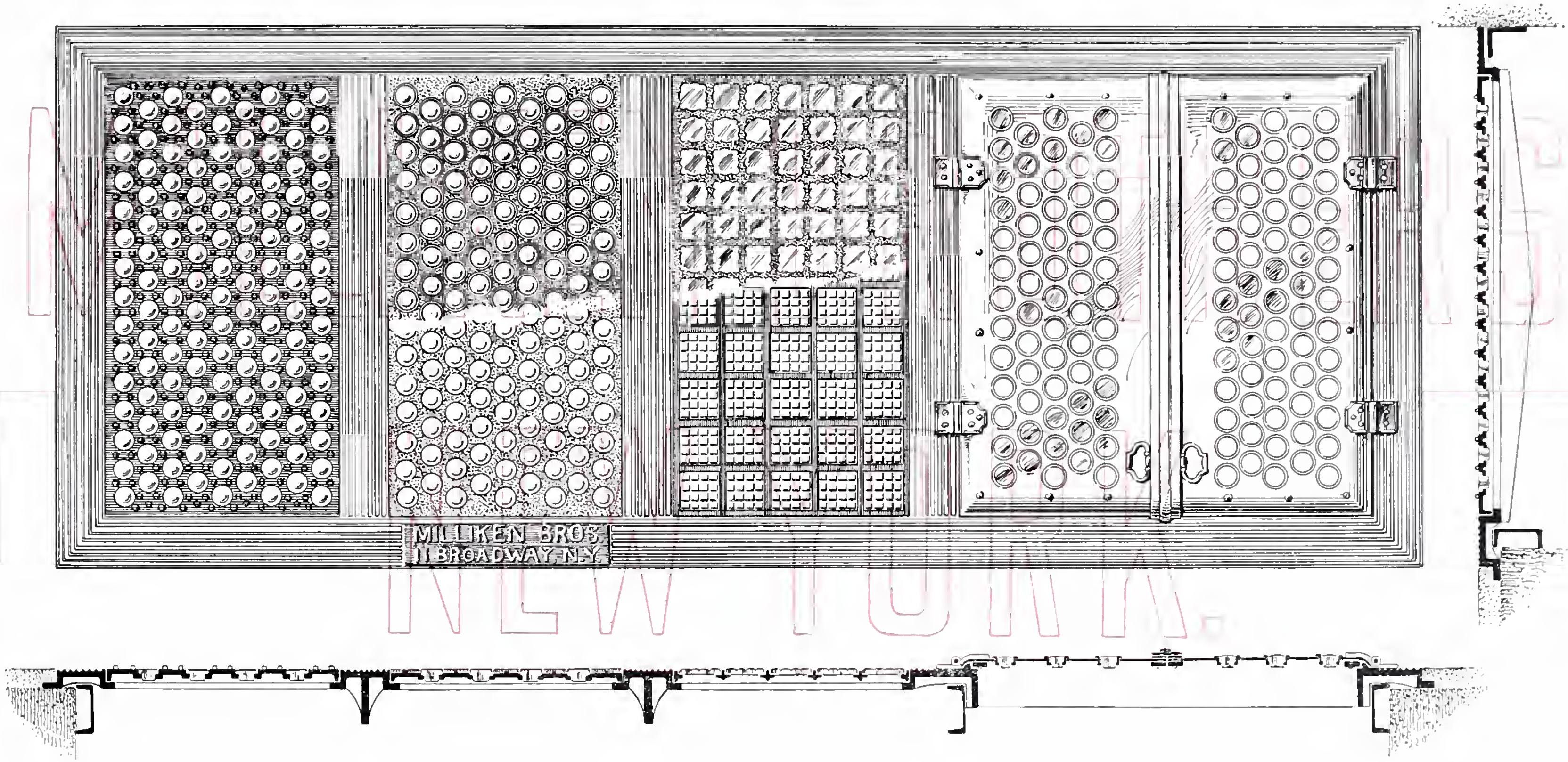
have brass hinges, padlocks and handles, also bars to brace them when open. Cheaper doors for sidewalks can be made of cast iron, with ordinary glass set in cement, instead of steel doors. Small doors can be lifted by hand; doors of very large size are furnished with worm gearing or quadrants by which same can be lifted from floor below. Doors are made absolutely water tight.

On page 355 we show a photograph of Illuminating Tiles, where the "Knob Light" is used in the sidewalk. These lights are in front of doorways where heavy goods are shipped. We also show steps with treads and risers with illuminating glass throwing the light down into the basement. The slanting doors are made of steel plates with lights set in brass rings. The small door is of similar construction and affords access to the boiler room under the sidewalk. The box ventilator has a glass top with ventilators or louvres at the sides for ventilating the boiler room.

We also furnish round covers and frames to be set in the sidewalk at the top of coal chutes, air shafts or for lighting vaults. Covers have either plain checkered tops or can be made of illuminating glass. We can also furnish these covers with open holes instead of glass, with a copper pan underneath to receive rain water. Between the pan and cover there is an open space for ventilation; and the rain water from the pan can be carried off by means of a small leader.

We also furnish glass for sidewalks of special design for radiating the light under the building itself instead of the light being thrown straight down. These lights are more expensive than the ordinary lights, and can be furnished in several designs.

Plate No. 77.



Rear of 585-587 Broadway, New York.

IRON WORK FURNISHED AND SET BY MILLIKEN BROTHERS.

CAST IRON ORNAMENTAL FRONT WORK FOR BUILDINGS.

On page 357 we show a photograph of ornamental cast iron frame-work for show window of department store, which is 18 feet high and 400 feet long with cast iron ventilating base between the sidewalk and bottom of show window and with cast iron ornamental and moulded cornices at top of window. These frames are well adapted for large windows and are specially designed for withstanding wind pressure.

On page 358 we give another photograph of cast iron front work two stories high for a store building. The sashes or windows in the first story are made in three sections. The upper section is stationary, while the lower sectious are made to slide up and down. The sashes are counter-weighted with ball-bearing hangers and pulleys, with flexible steel wire ropes and can be easily lifted by one person. The counter-weights are enclosed in a box on the inside of front. This style of store front is specially adapted for the display of goods and merchandise, as the entire front of the store is thrown open in warm weather, and in cold or stormy weather the sashes can be pulled down, thus entirely enclosing the front of the store.

We also furnish frames for single windows for office buildings or for store buildings, either of cast iron or of solid bronze.

On page 355 we show a photograph of ornamental cast iron mullions or posts on front of building with moulded cast iron sills and transoms separating the various doors and windows. These mullions are also used as supporting columns when necessary, and can be made of any required thickness.

Siegel-Cooper Store, 18th and 19th Streets and Sixth Avenue, New York.

IRON WORK FURNISHED AND ERECTED BY MILLIKEN BROTHERS.

STORE BUILDING, 16TH STREET AND SIXTH AVENUE, NEW YORK.

IRON WORK FURNISHED AND ERECTED BY MILLIKEN BROTHERS.

GATES, LAMPS AND FOUNTAINS.

Gates can be made of various designs, either folding, swinging or lifting. On Plate No. 78 is represented folding gates which we have furnished at the ground floor entrance of elevators in an office building. These gates are divided in the centre and slide each way, the halves being connected overhead at the back of the transom by pulleys and an endless chain so arranged that when one-half of the gate is opened the other opens at the same time automatically; in this way the entire front of the elevator car is thrown open to allow free entrance or exit of passengers. These gates are also connected by an automatic attachment on top of the car so that they can only be opened when the car is opposite the gate. These gates are made of solid bronze but we can also furnish them of wrought iron or steel either painted or electroplated in imitation of bronze. They can be used either for elevator gates or for entrance doorways.

On page 355 we show a photograph of plain folding gates made of steel, for shipping entrances

On Plates Nos. 79 and 80 are indicated designs of ornamental folding gates for private residences. These gates can be furnished either of wrought iron or of bronze. The gate shown on Plate No. 80 is made of wrought iron with hammered leaf work of the highest quality and finish, equal to the best examples of French workmanship.

On page 372 we show a sample of wrought iron stationary grille work for private residence which is

finished in "Verde Antique" of various shades of green in imitation of old copper, oxidized by exposure to the weather; this presents a very rich effect.

On Plate No. 81 we give designs of iron lamps which we have recently furnished for a building in Mexico. These lamps have beveled plate glass on six sides and can be finished either for electric light, gas or oil, and can be made of any size from 2 to 8 feet in height; they can also be furnished in solid bronze.

We also furnish lamp posts with globes at the top, either for electric light or gas, as indicated on Plate No. 82.

On this same plate we give design of a fountain, which can be furnished in any size from 8 to 30 feet in height, suitable for private gardens or for public parks. These fountains are made of cast iron, painted, or if required can be electroplated in imitation of bronze, or can be finished in "Verde Antique" in imitation of oxidized copper.

Plate No. 78.

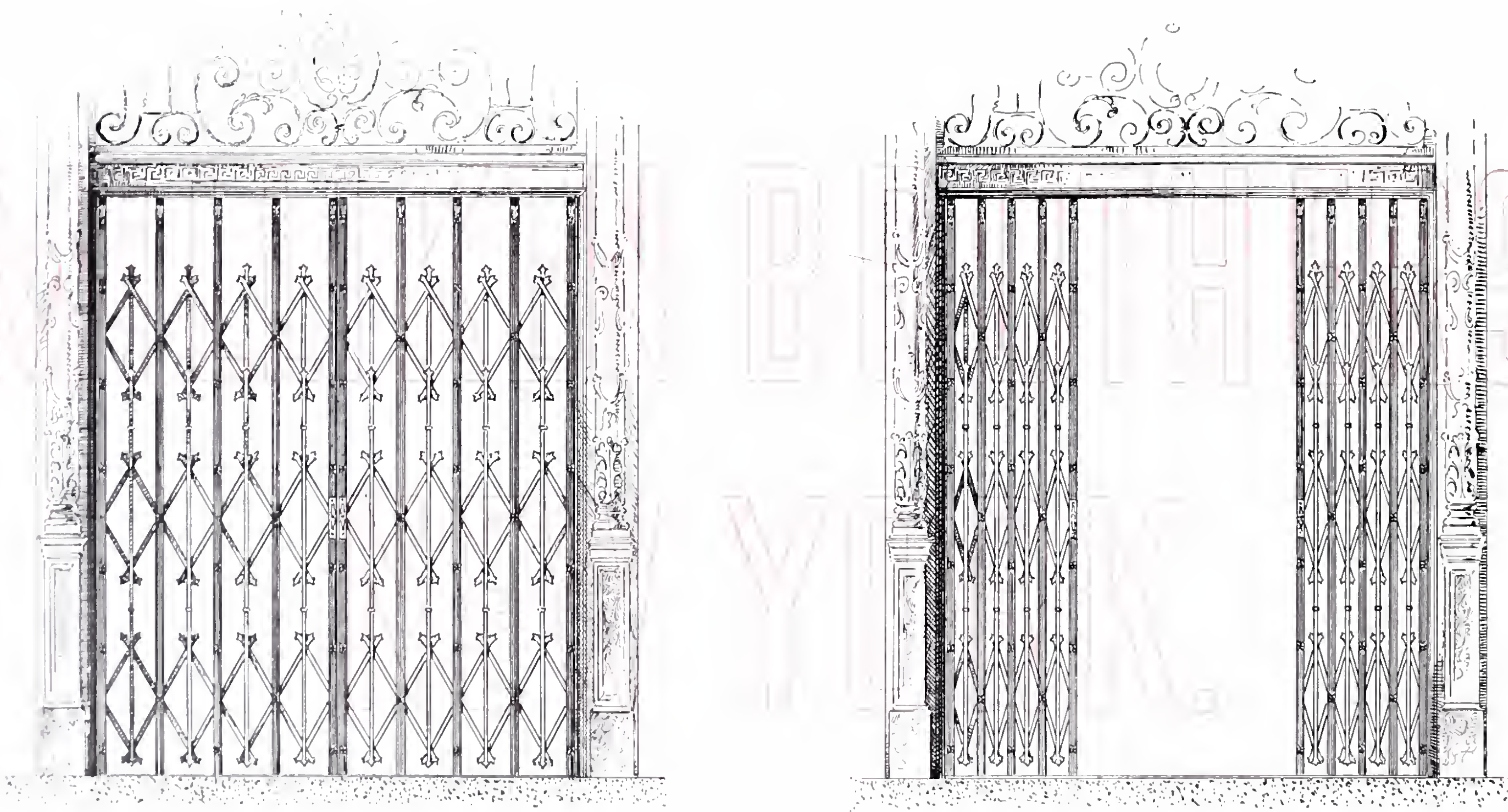


Plate No. 79.

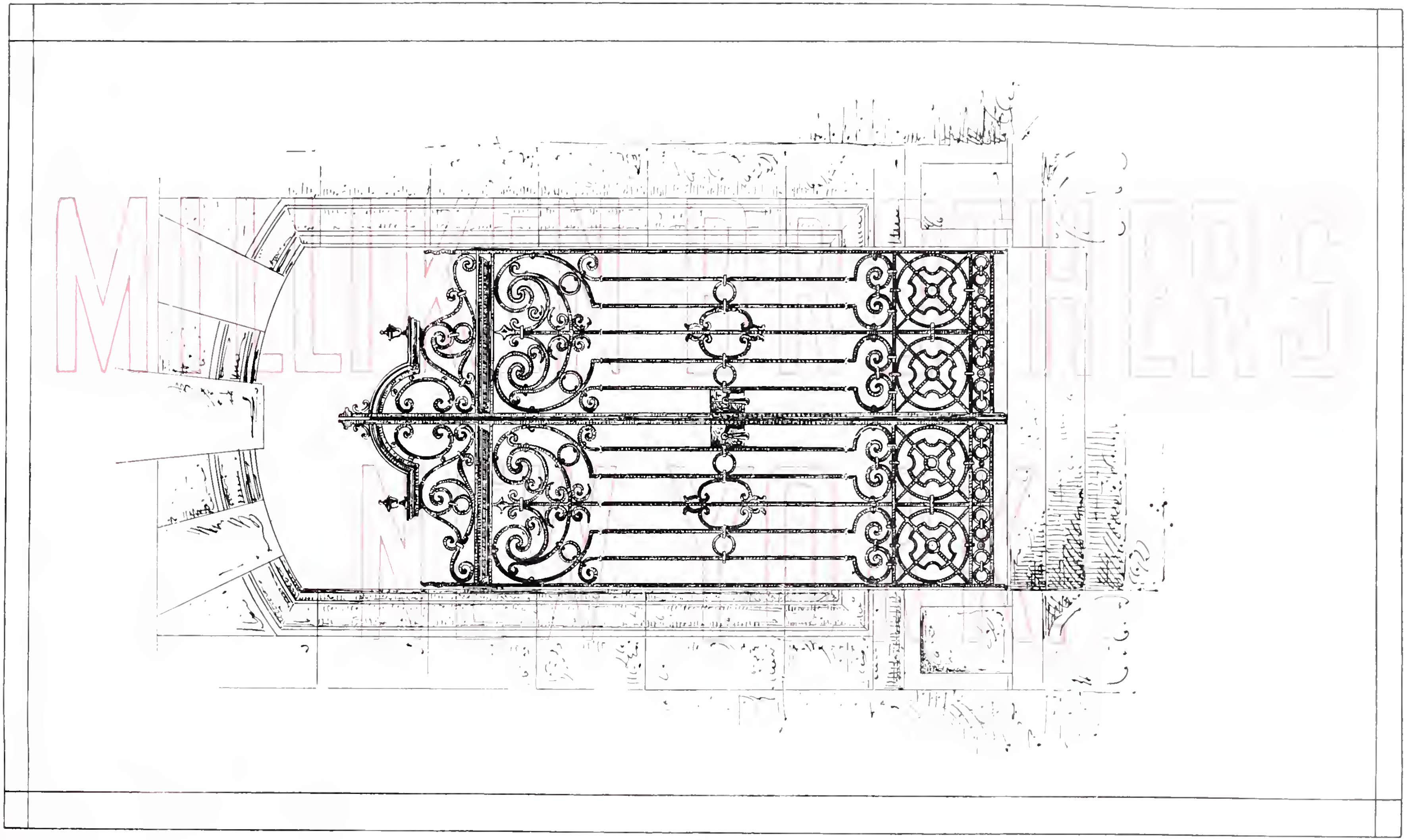


Plate No. 80.

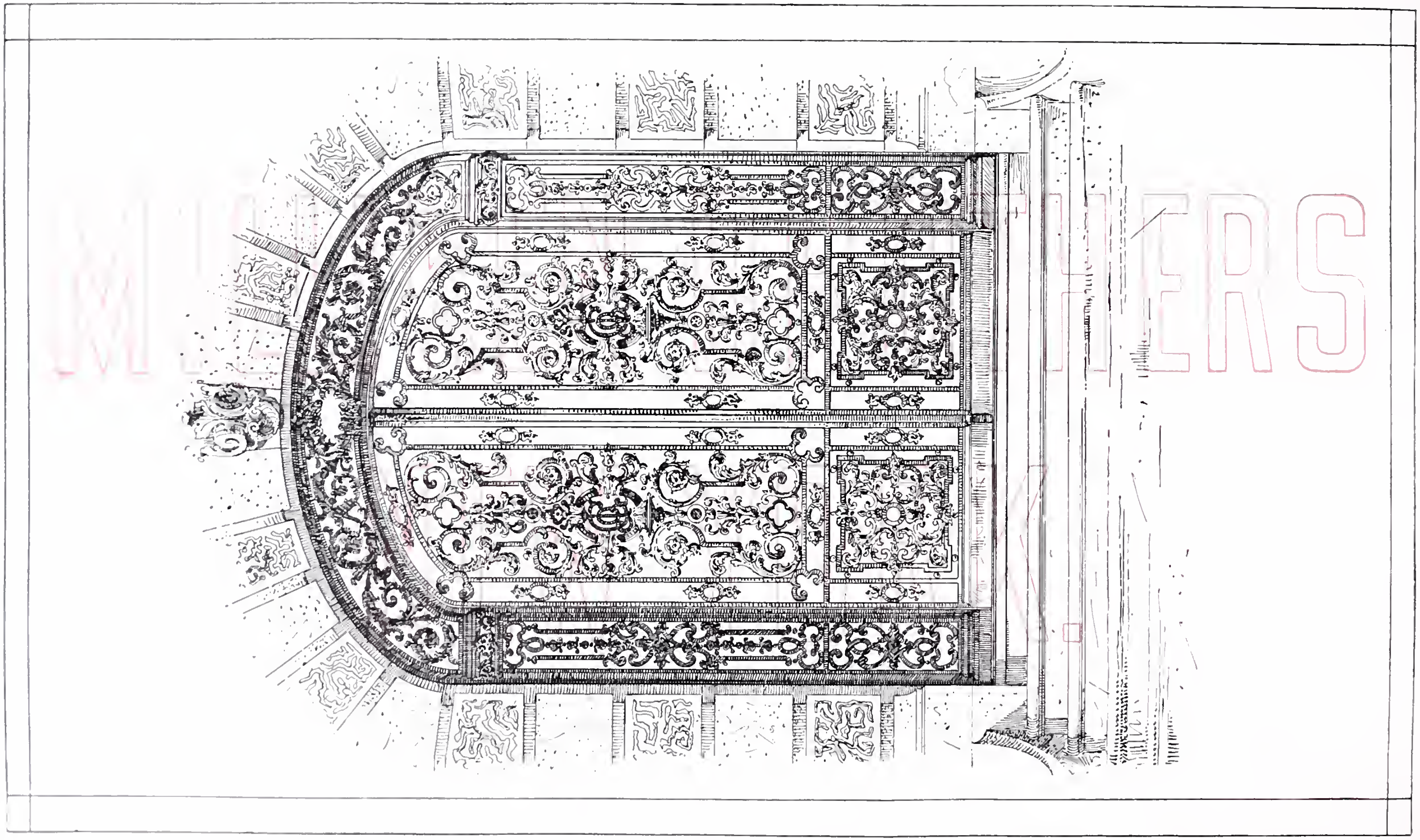


Plate No. 81.

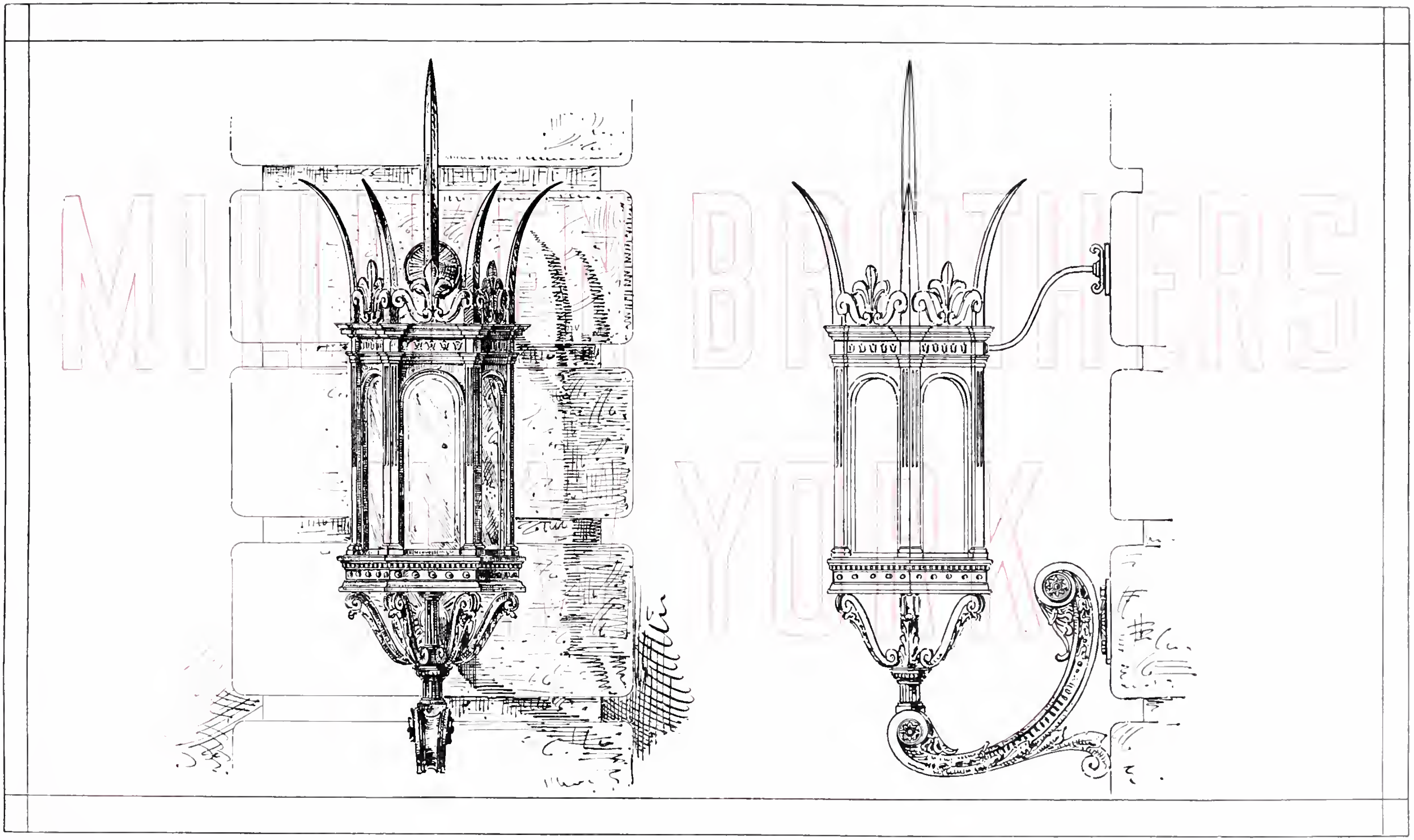
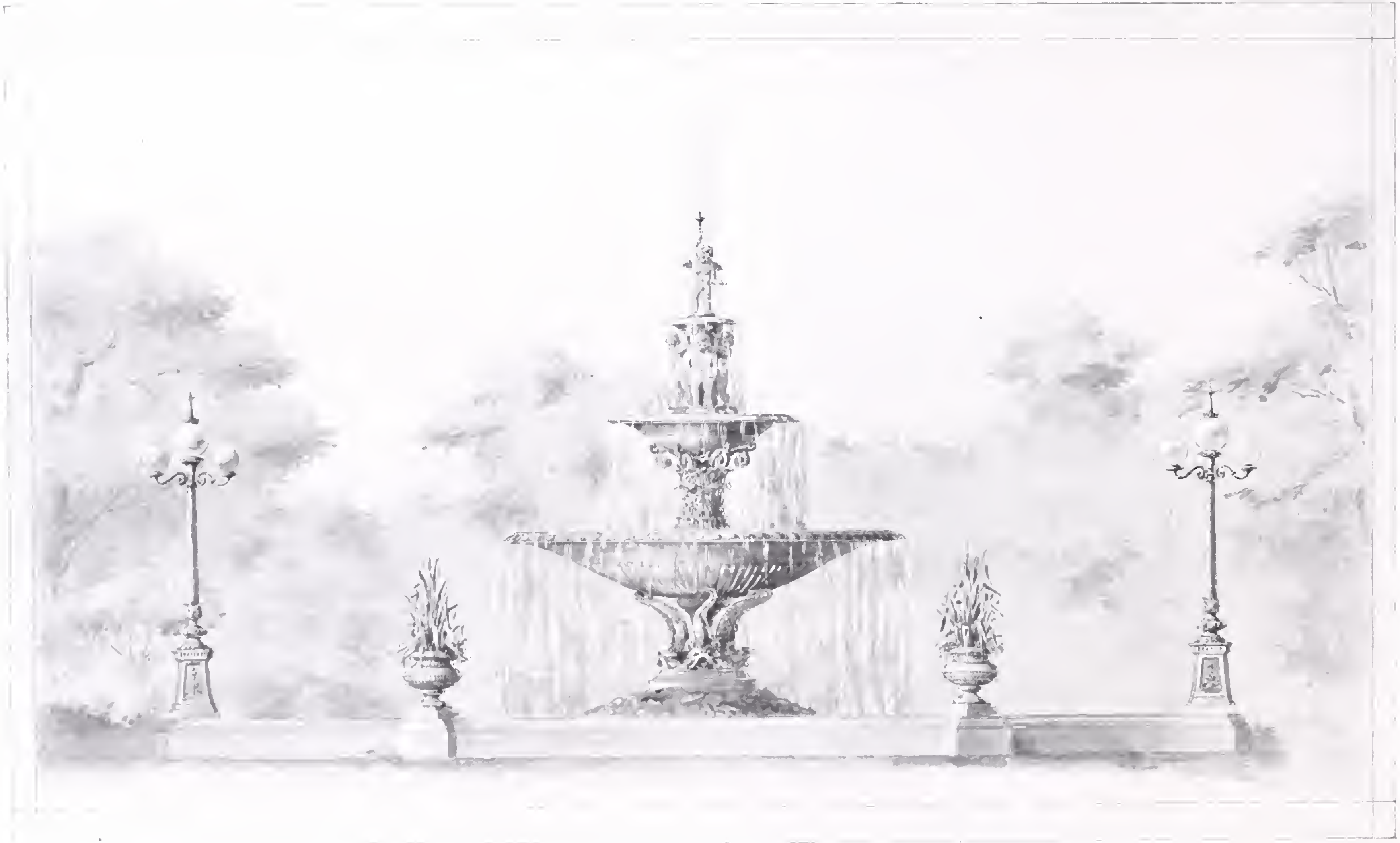


Plate No. 82.



Ornamental Front Entrance Gate. Residence, New York City.

WORK DESIGNED, FURNISHED AND ERECTED BY MILLIKEN BROTHERS.

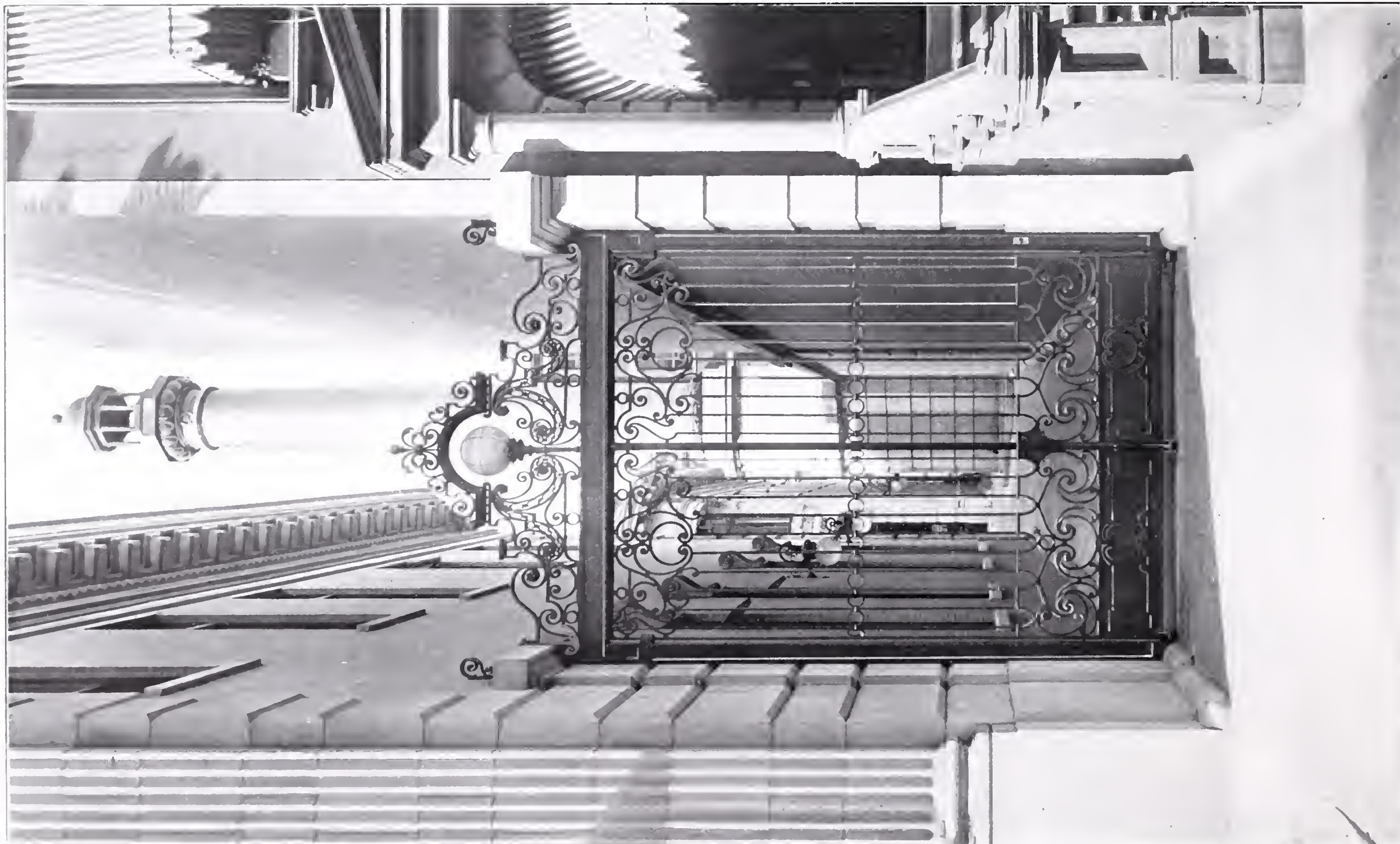
ORNAMENTAL FRONT ENTRANCE GATES. RESIDENCE, NEW YORK CITY.

WORK DESIGNED, FURNISHED AND ERECTED BY MILLIKEN BROTHERS.

ORNAMENTAL FENCE AND ENTRANCE WORK. MR. ROBBINS' RESIDENCE, NEW YORK CITY.

WORK DESIGNED, FURNISHED AND ERECTED BY MILLIKEN BROTHERS.

Driveway Gates, Windsor Arcade, New York City.



WORK DESIGNED, FURNISHED AND ERECTED BY MILLIKEN BROTHERS.

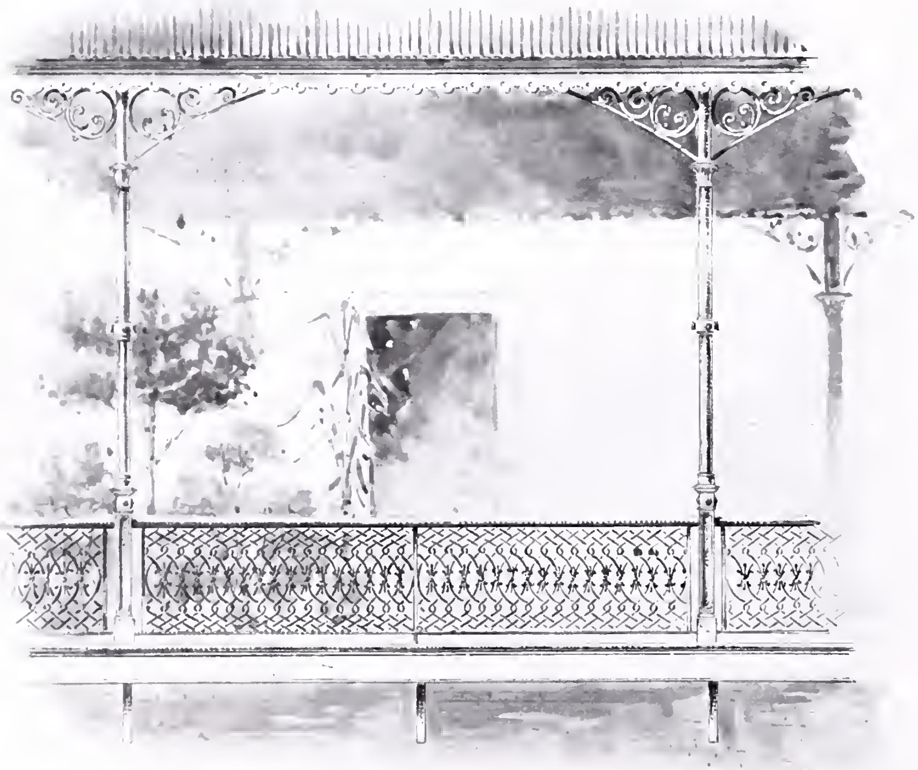
BALCONIES, PORTICOS, MARQUISES, CANOPIES AND PORTE-COCHERES.

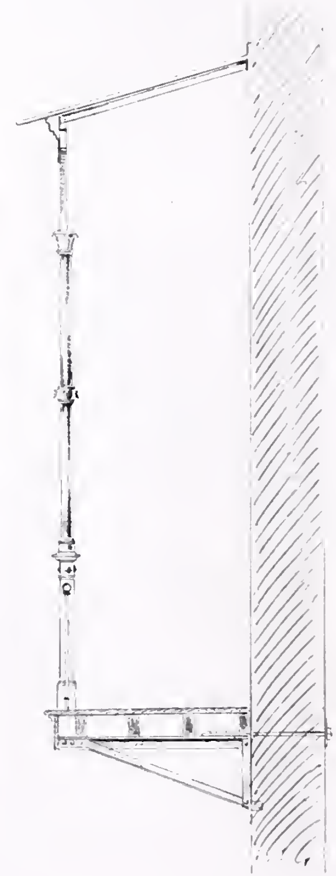
Iron balconies of either plain or ornamental design can be furnished for the outside of private or public buildings. On Plate No. 83 we show sketch of a simple balcony with corrugated iron roof, wrought and cast iron posts, wrought iron scroll braces and cast iron railing. The iron railing can be furnished of any design and may be either of wrought or cast iron. See Plates Nos. 84, 85, 86 and 87. The floor of the balcony is shown of wood supported on wrought iron brackets bolted through the wall. The floor can be furnished of cast iron or of steel plates if desired.

On page 372 we give a photograph of a canopy or portico enclosure over stone terrace for private house. This portico has a glass roof and is supported on a wrought iron ornamental framework with hammered leaf ornaments. The cornice and roof bars supporting the glass are of copper. The glass at the side of enclosure is removable and can be taken out in summer and put back in winter. Similar canopies can be furnished for entrances to either private residences, stores or office buildings, supported on columns or brackets.

Porte-cocheres also can be furnished over driveways supported by columns, with solid roof covering instead of glass.

Plate No. 83.





Iron Work Furnished and Erected by Milliken Brothers.

Porte-Cochere and Railings for Hotel Marlton, West 8th Street, New York City.

WORK DESIGNED, FURNISHED AND ERECTED BY MILLIKEN BROTHERS.

MARQUISE AND STORM VESTIBULE FOR THEATRE MAJESTIC, NEW YORK CITY.

WORK DESIGNED, FURNISHED AND ERECTED BY MILLIKEN BROTHERS.

PORTE-COCHERE FOR THEATRE MAJESTIC, NEW YORK CITY.

WORK DESIGNED, FURNISHED AND ERECTED BY MILLIKEN BROTHERS.

PORTE-COCHERE FOR HOTEL NAVARRE, 38TH STREET AND SEVENTH AVENUE, NEW YORK CITY.

WORK DESIGNED, FURNISHED AND ERECTED BY MILLIKEN BROTHERS.

RAILINGS.

We furnish railings of various materials and designs, either of cast iron, brass or bronze. On Plates Nos. 84, 85 and 86, we show designs of plain and ornamental railings.

On plate No. 87 we show designs of wrought iron railings furnished by us for a private house. These railings are ornamented with hammered leaf work, double faced, of very fine workmanship and equal to the best work of French artisans. These railings can be made of iron, electroplated in imitation of bronze or painted. A dull black finish with the tips of the leaves gilded gives a very rich and beautiful effect.

On Plate No. 88 we show design of cast iron railing for stairs executed by us; and on pages 386, 387 and 388 wrought iron railings for stairs which are electroplated in imitation of bronze.

Pipe railings can be furnished either in bronze, brass or wrought iron, with plain or ball fittings, and if desired, ornamented with scroll work. Pipes or tubes from 1 inch to 3½ inches outside diameter for either posts or rails.

Plate No. 84.

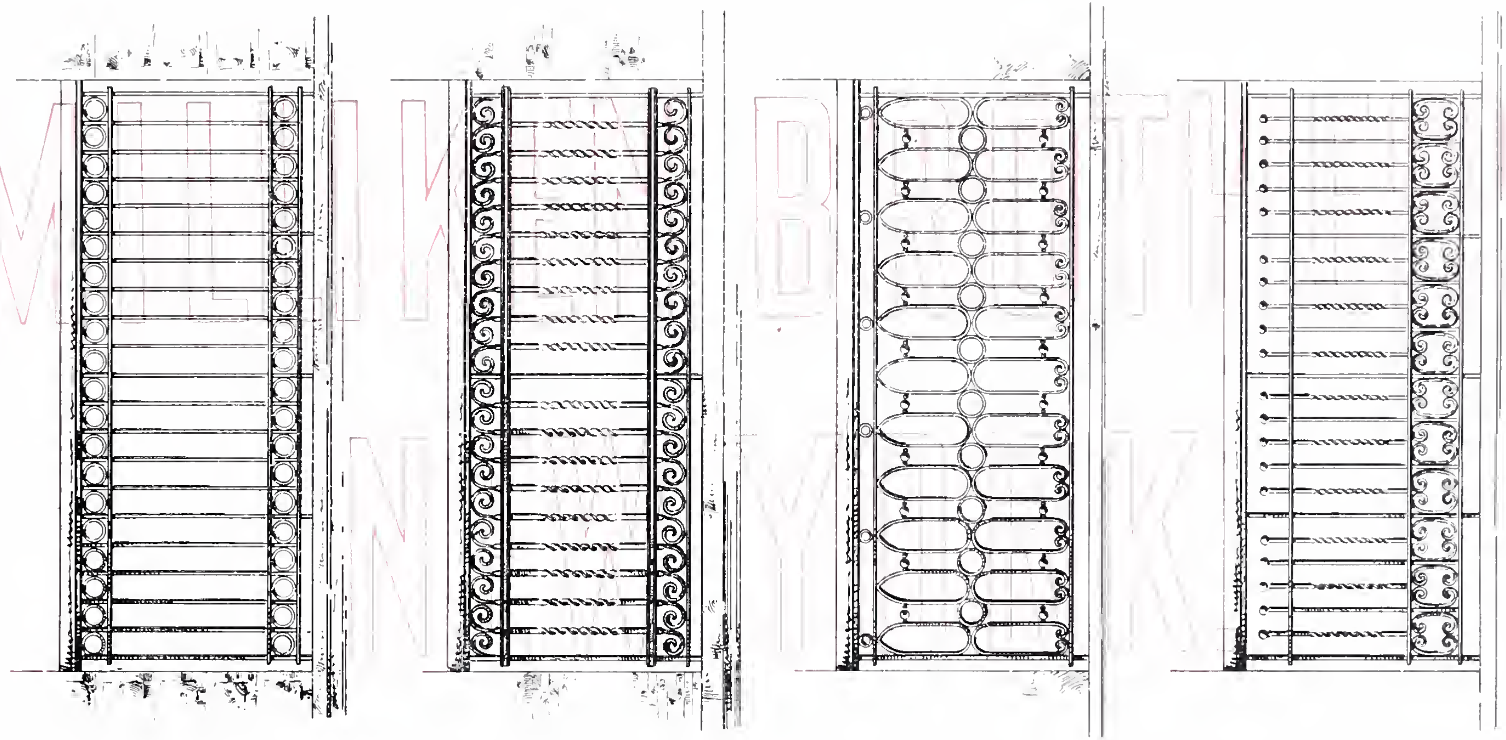


Plate No. 85.

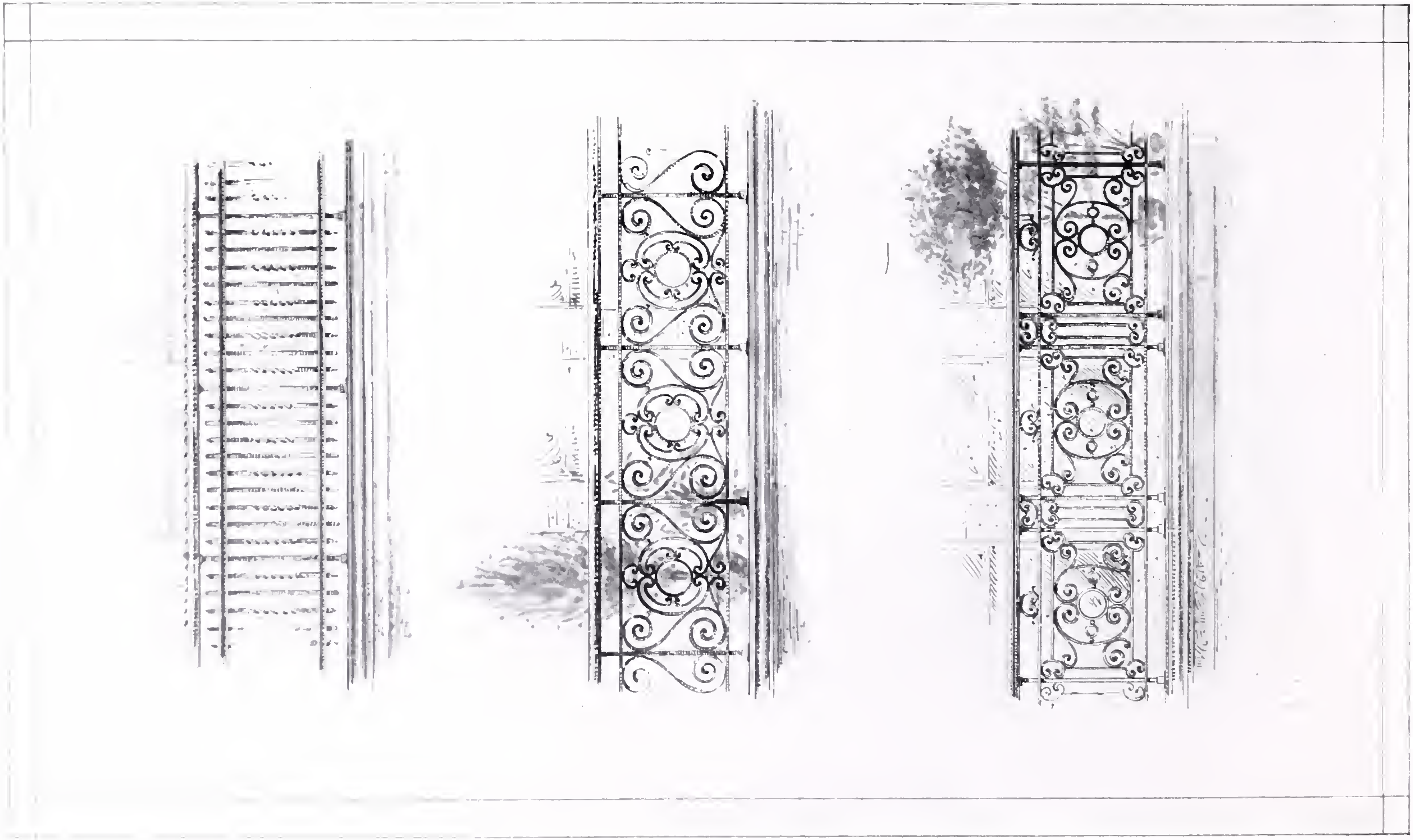


Plate No. 86.

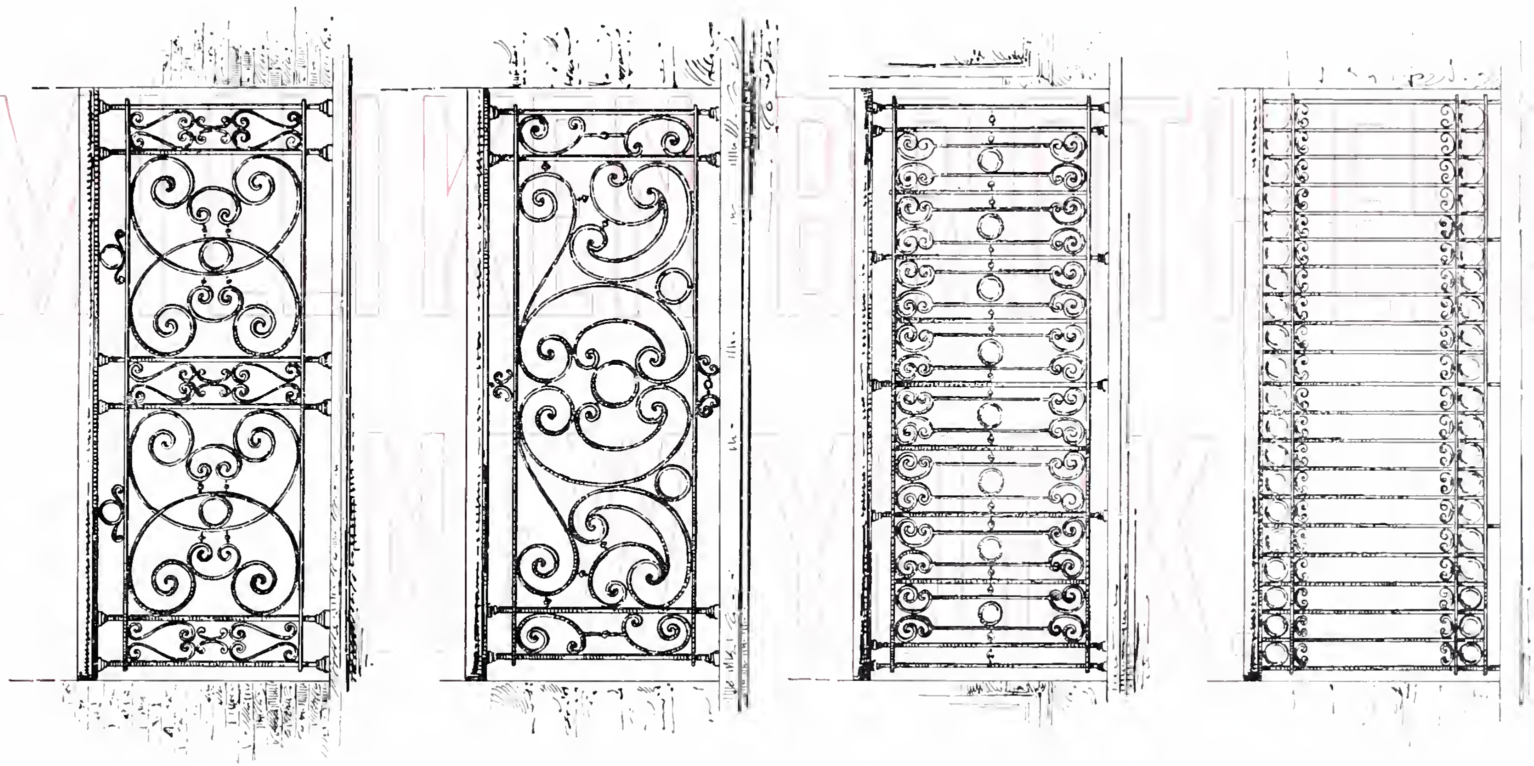
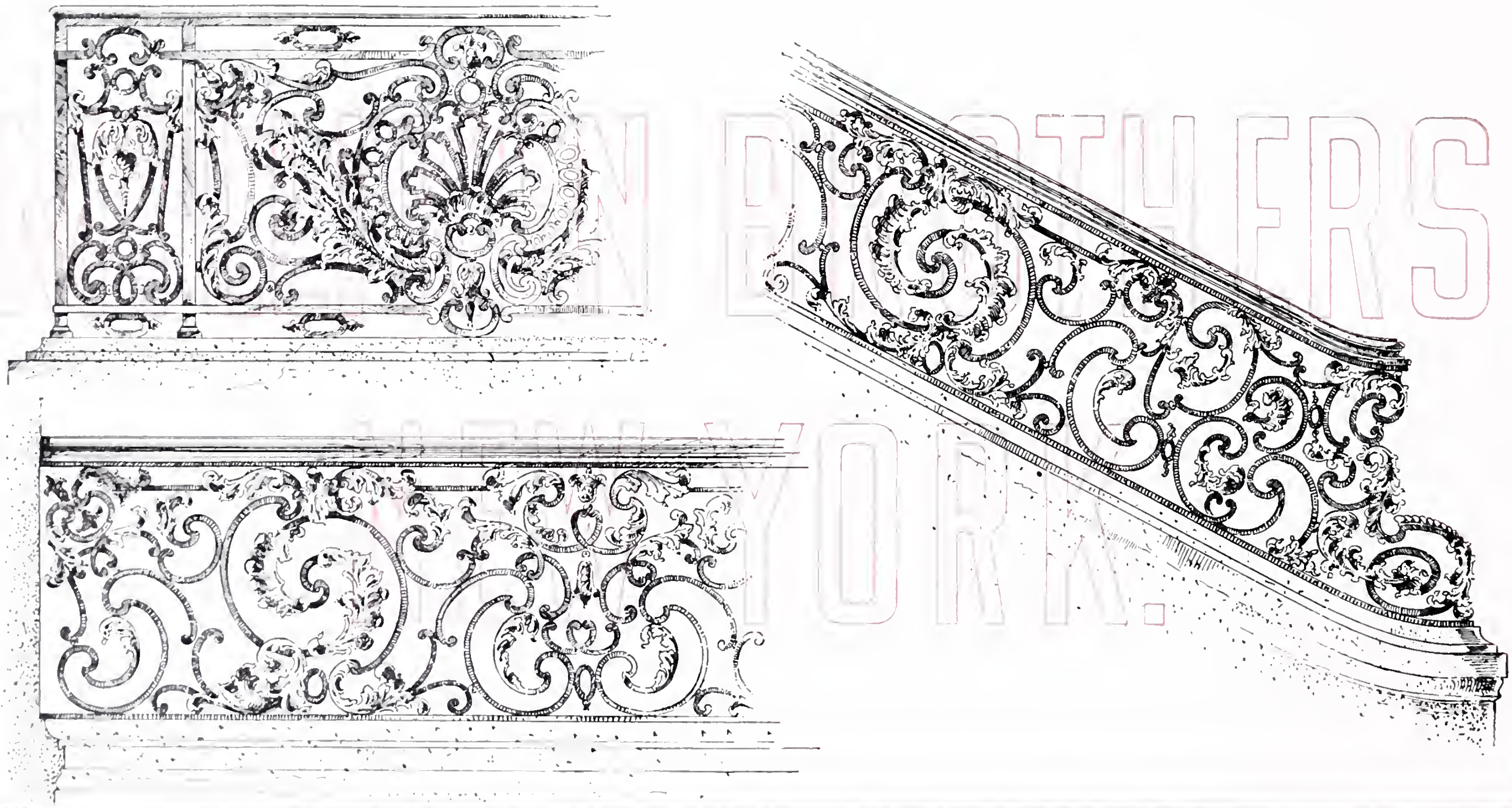


Plate No. 87.



IRON WORK DESIGNED, FURNISHED AND ERECTED BY MILLIKEN BROTHERS.

STAIRCASES.

We furnish iron staircases of any design, either of wrought or cast iron. Circular stairs are made with a center supporting column and are from 4 feet to 7 feet in diameter. Plain stairs can be furnished for factory or mill buildings with channel iron strings or carriages, cast iron or wooden treads, with bar iron or pipe railings.

We furnish stairs of ornamental character for stores and office buildings, also for private houses. On Plate No. 88 we show design of 36 flights of stairs which we have furnished for a large store and loft building in New York City. These stairs are built entirely of cast iron with the exception of the treads. The entire work is electroplated in imitation of bronze.

We give a photograph of office building stairs on page 388. These stairs have cast iron strings or carriages with cast iron risers, newel posts and fascias or aprons to cover over floors. The railings are entirely of wrought iron.

On page 386 we give a photograph of a staircase of special construction which we have furnished for an office building. This staircase is 13 stories in height and is constructed without any horizontal supports at the platforms or floor levels; and in this respect this staircase is unique and different from any other stair in this country. The great weight of the carriages or stair strings, with the railings and steps, in addition

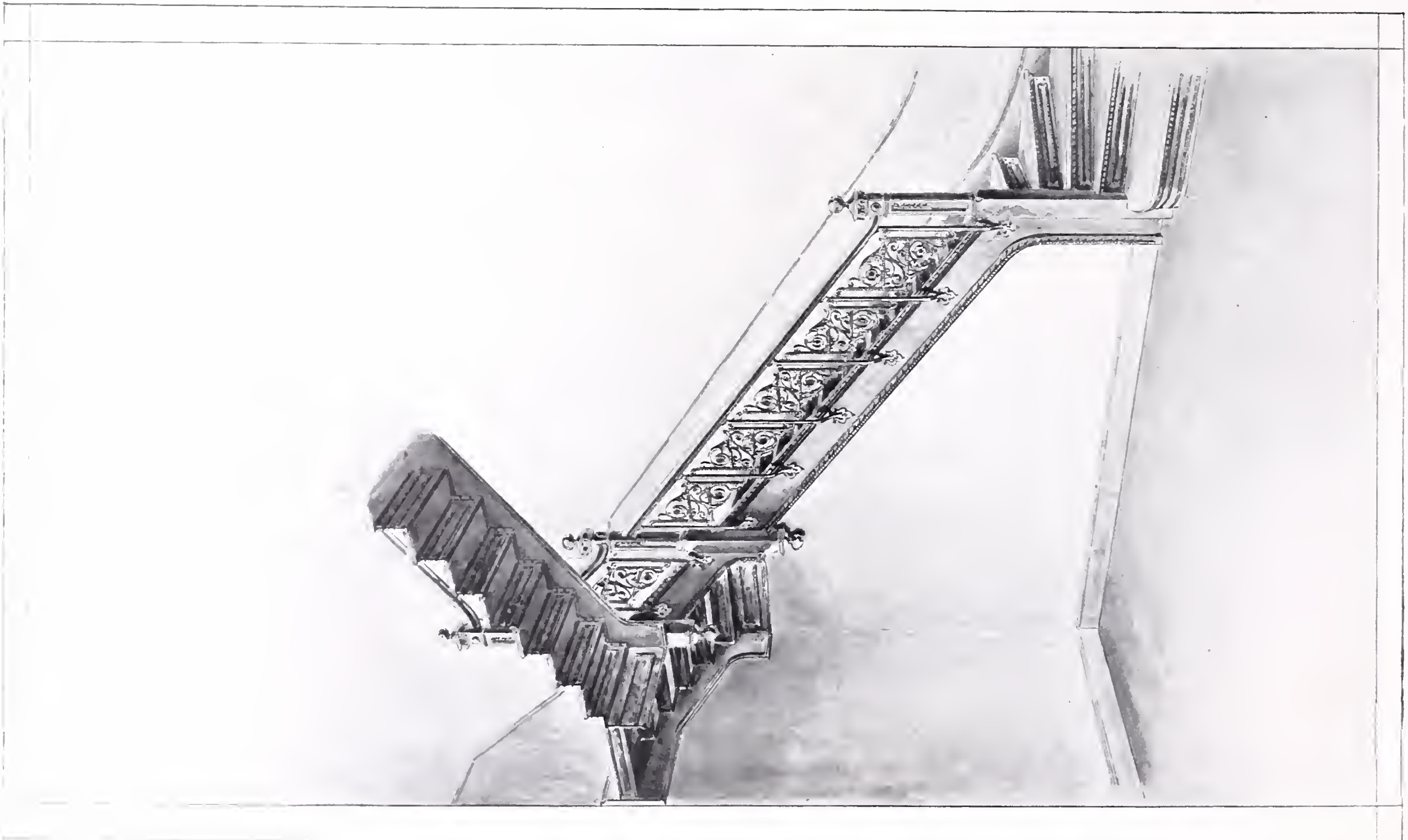
to the moving load, is carried by the risers, each of which acts as a cantilever and transmits the load directly to the wall strings. These wall strings are reinforced at various points to withstand the unusual strains imposed. The curves or ramps, where the stairs turn, are built to a perfect line notwithstanding the great difficulty of moulding and casting. We give a photograph on page 387 of these same stairs, looking down from the top of the building, which gives a good illustration of the difficulties encountered in building them without any supports at floors. These stairs are electroplated in imitation of bronze.

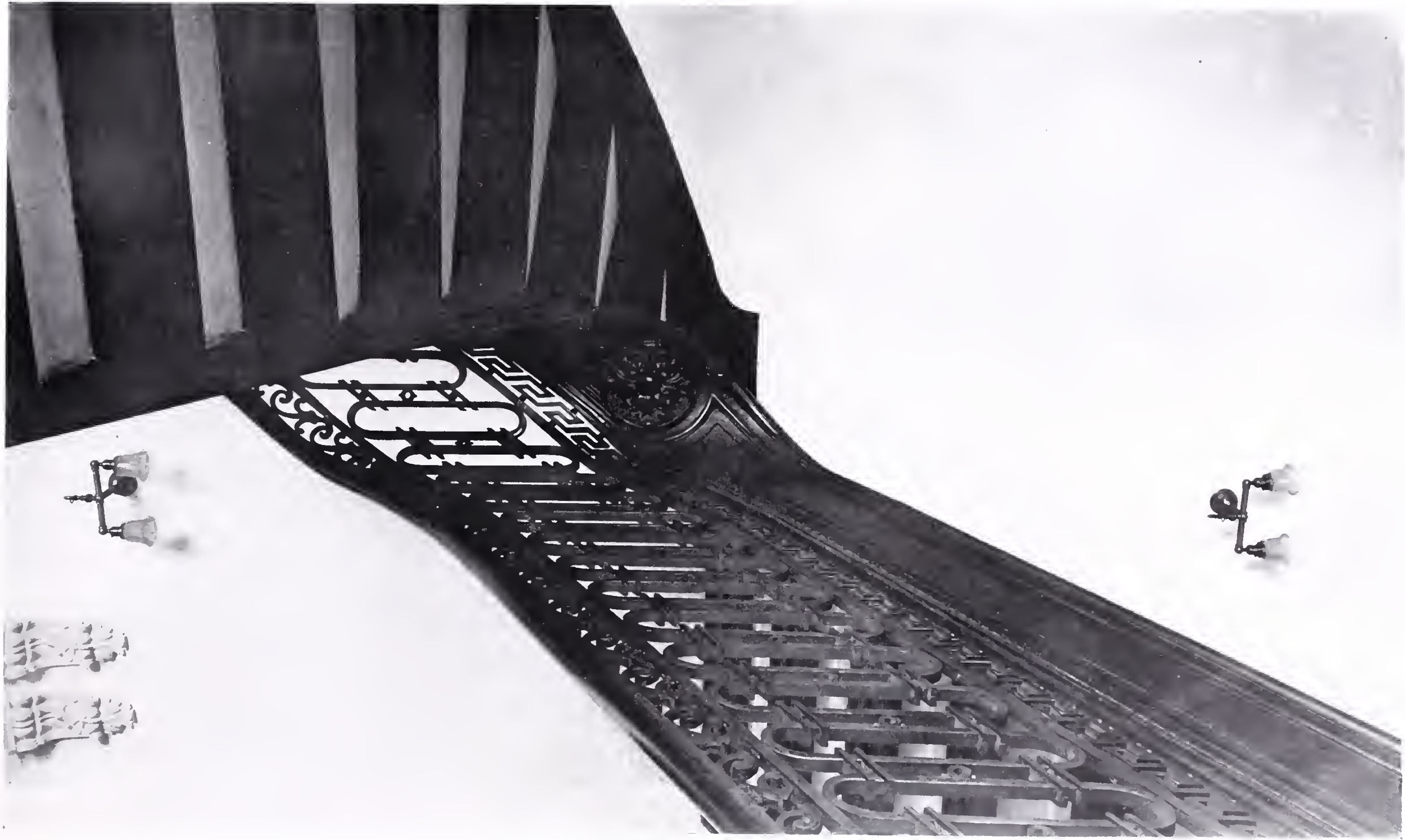
A very ornamental stair railing is shown on Plate No. 87 which we have furnished for a private residence. This stair is of wrought iron with hammered leaf ornaments, double faced.

On page 398 we show a photograph of staircase which we have built for a store building. These stairs extend around the elevator shaft thus economizing space in the store and also lessening the cost of the elevator enclosure, as the stair railing becomes a portion of the enclosure. This design is economical and yet presents an ornamental and very pleasing effect.

A unique and decidedly beautiful staircase is shown on Page 393. This stair, on account of the curved ramps, etc., is one of the most difficult to build, requiring careful fitting by expert mechanics. We have a special corps of expert designers to detail each scroll, ornament, etc., to actual full size as fast as the work progresses in the shops.

Plate No. 88.



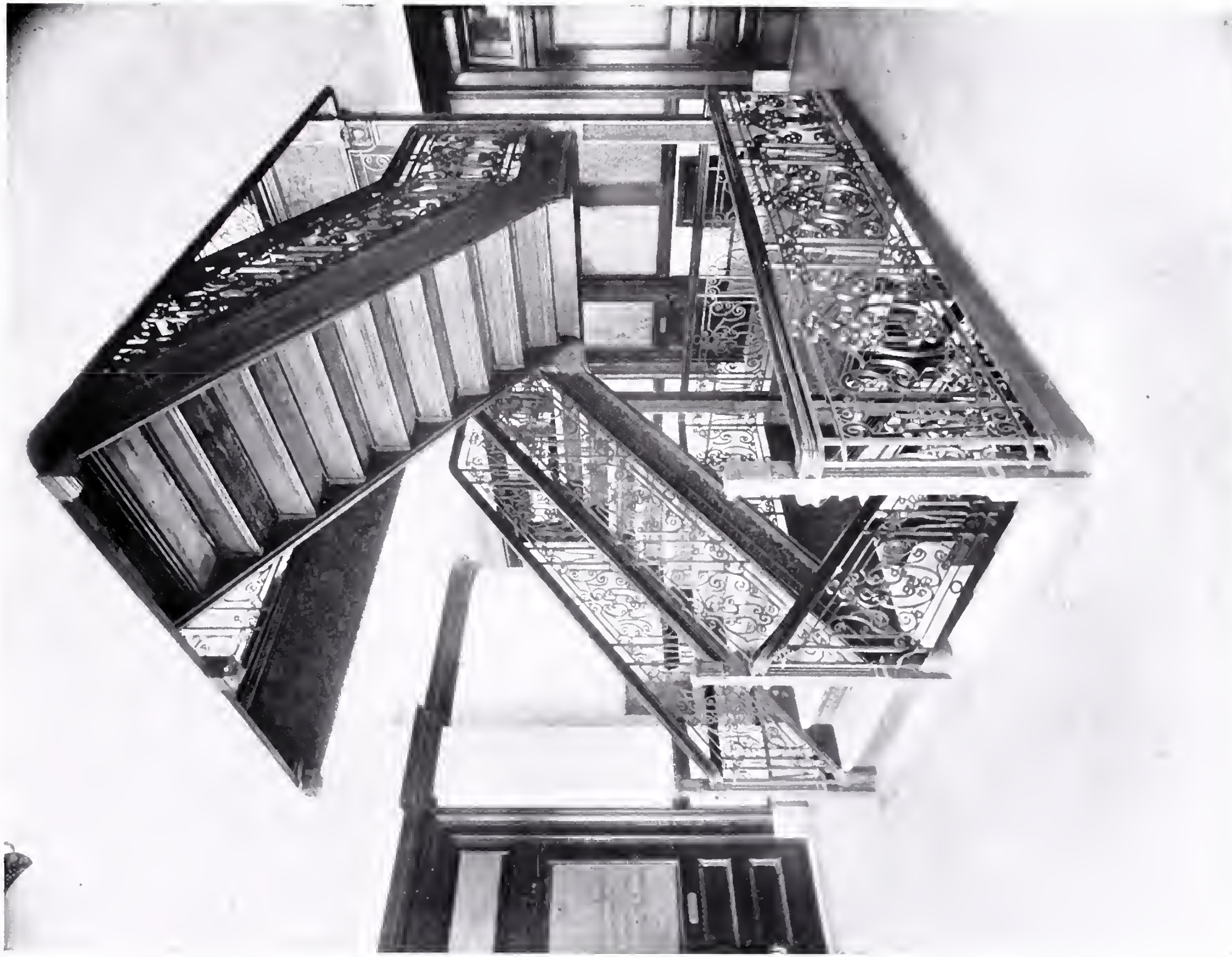


IRON WORK FURNISHED AND ERECTED BY MILLIKEN BROTHERS.

Bourne Office Building, 85 Liberty Street, New York.

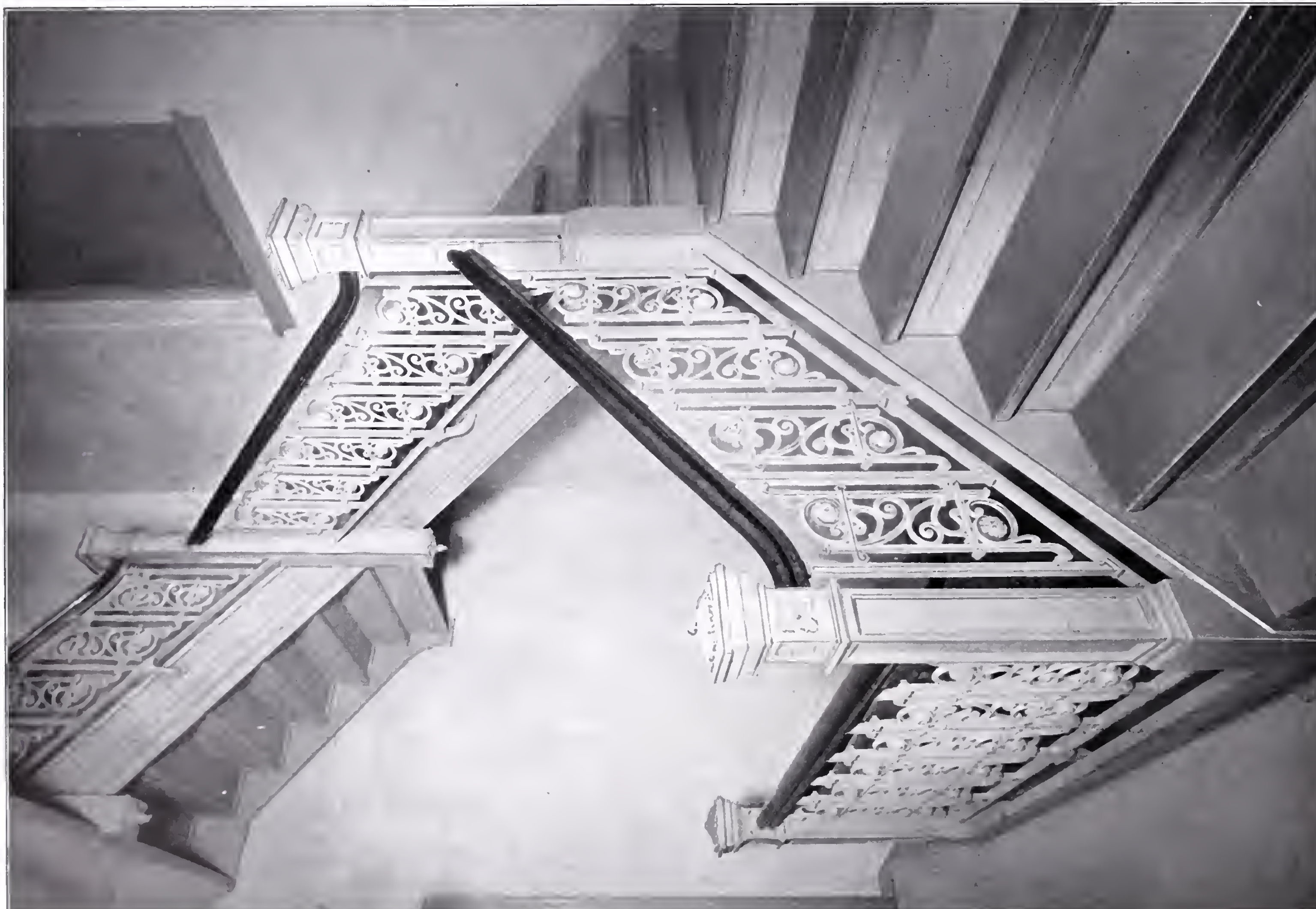
IRON WORK FURNISHED AND ERECTED BY MILLIKEN BROTHERS.

DUN BUILDING, READE STREET AND BROADWAY, NEW YORK.



IRON WORK FURNISHED AND ERECTED BY MILLIKEN BROTHERS.

STAIRS FOR DAYSIDE NURSERY, NEW YORK CITY.



WORK DESIGNED, FURNISHED AND ERECTED BY MILLIKEN BROTHERS.

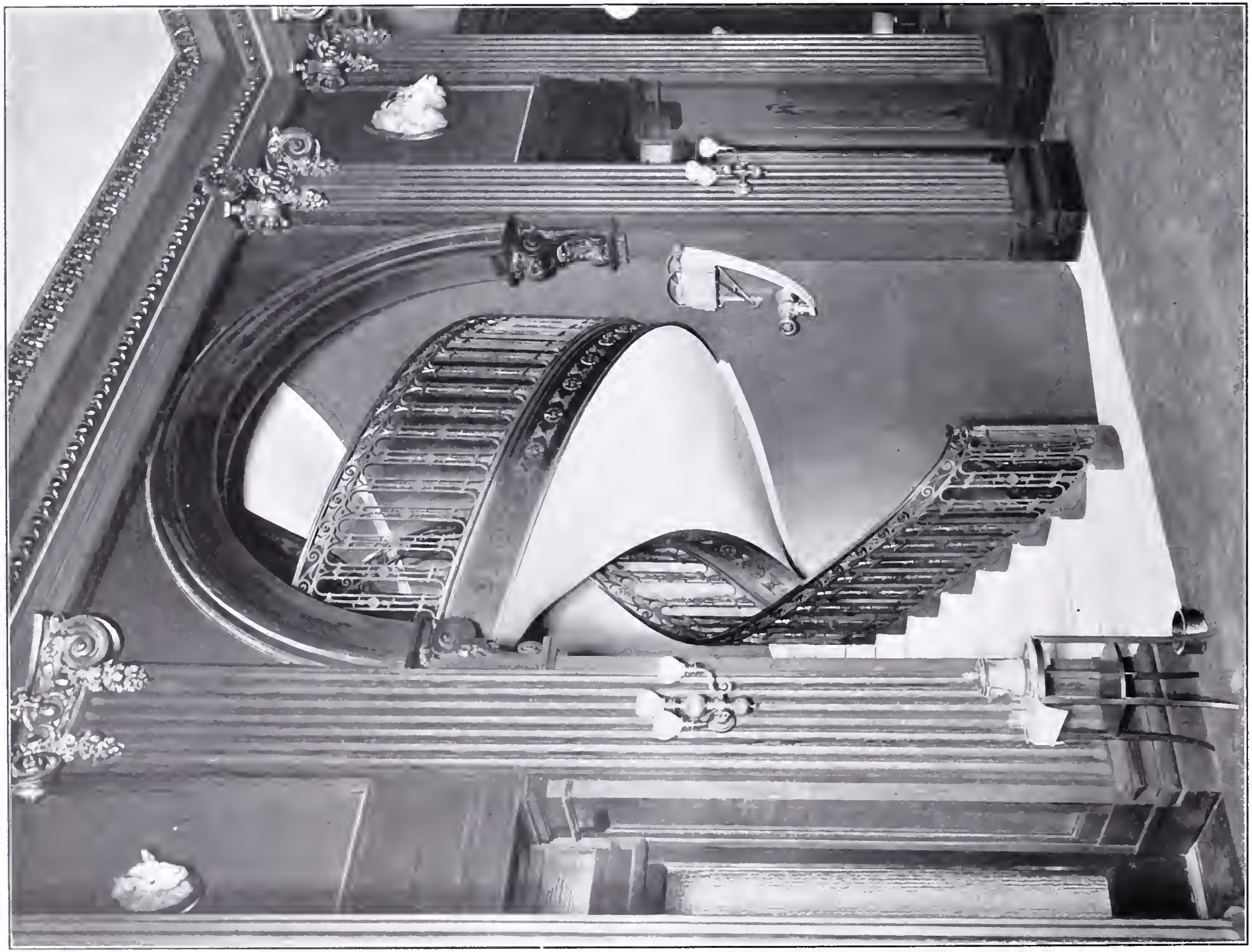
STAIRS FOR MORNINGSIDE DORMITORY, 121ST STREET AND AMSTERDAM AVENUE, NEW YORK CITY.

WORK DESIGNED, FURNISHED AND ERECTED BY MILLIKEN BROTHERS.

Work designed, furnished and erected by Milliken Brothers.

WORK DESIGNED, FURNISHED AND ERECTED BY MILLIKEN BROTHERS.

Circular Stairs, Yale Club, West 44th Street, New York City.



WORK DESIGNED, FURNISHED AND ERECTED BY MILLIKEN BROTHERS.

ENCLOSURES FOR ELEVATOR SHAFTS.

Owing to the large increase of elevators in recent years, especially for office buildings, in both this country and abroad, the method of enclosing the elevator shafts so as to prevent accident has been a matter of increasing study, both as to construction and ornamentation. We have furnished many enclosures of wrought and cast iron, also of bronze.

On Plate No. 89 we show a design of enclosure for two elevators which we have furnished for a store building. The gate is in the center of shaft and is made in two parts, each half of the gate sliding automatically by means of chains and overhead pulleys. When one-half of the gate is opened the other half slides of its own accord. The base of the enclosure, up to a height of 3 feet, is built of cast iron. The grille work above is of wrought iron of a close design surmounted by an ornamental cast iron transom. The upper portion of the enclosure between the transom and ceiling, is filled with open grille work sufficiently strong to prevent anyone from falling out of the car.

We show a similar design on Plate No. 90, excepting that the gate is smaller, and only one-half of the front slides while the other half remains stationary.

We show a photograph on page 398 of an elevator enclosure in connection with a staircase for a store building, which is economical in cost as well as ornamental.

The elevator enclosure shown on page 404 is constructed with a cast iron framework, and the openings are filled with wrought iron grilles and frames backed up with ground glass, preventing any noise or draught from the shaft. The iron work of this enclosure is all electroplated in imitation of bronze, with all the high flat surfaces polished.

The enclosure shown on page 399 is built entirely of solid bronze with automatic folding gates. This enclosure, as to design and finish and the large amount of bronze used in its construction, is one of the finest ever made.

We also give a photograph of a counter screen for business offices, on page 404. This is built entirely of solid bronze with small wickets or gates suitable for banking offices, with a glass shelf projecting on the outside supported on bronze brackets. This counter screen can be furnished either of bronze, cast or wrought iron painted, or of wrought iron electroplated in imitation of bronze.

Plate No. 89.

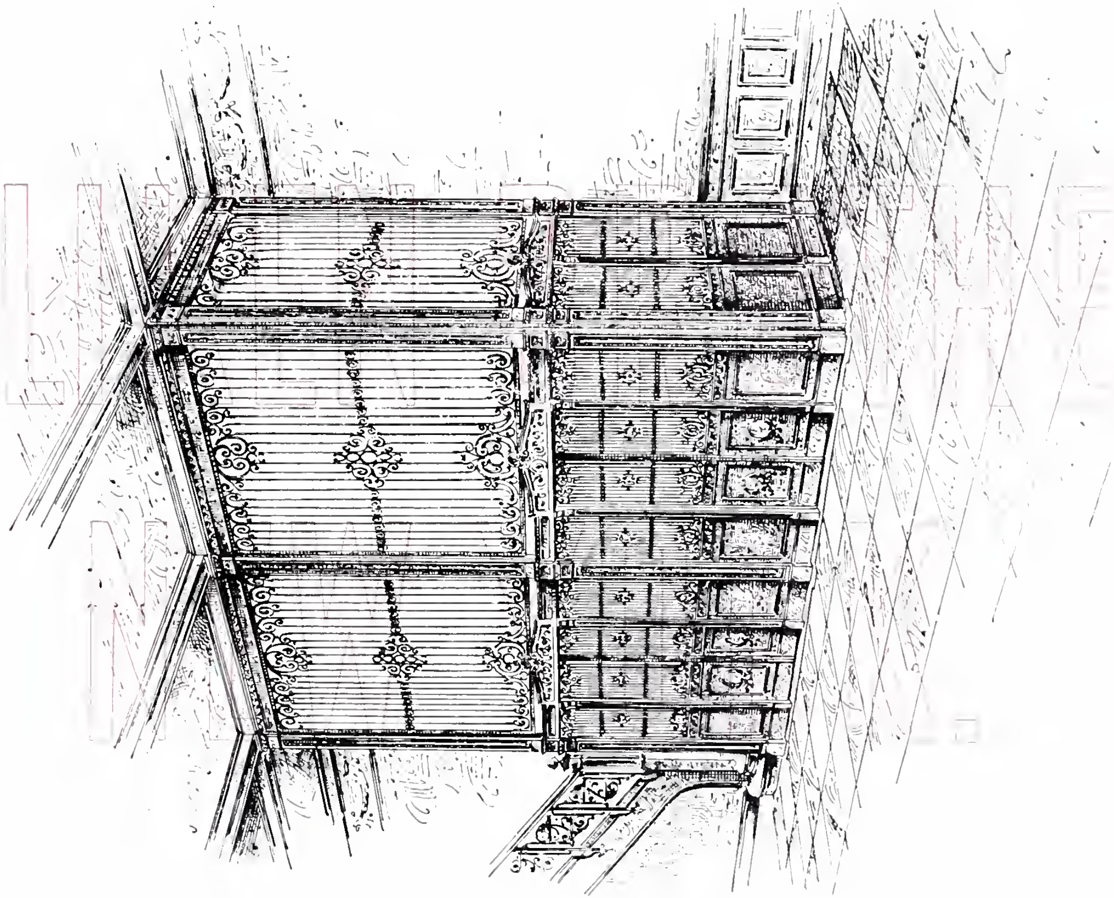
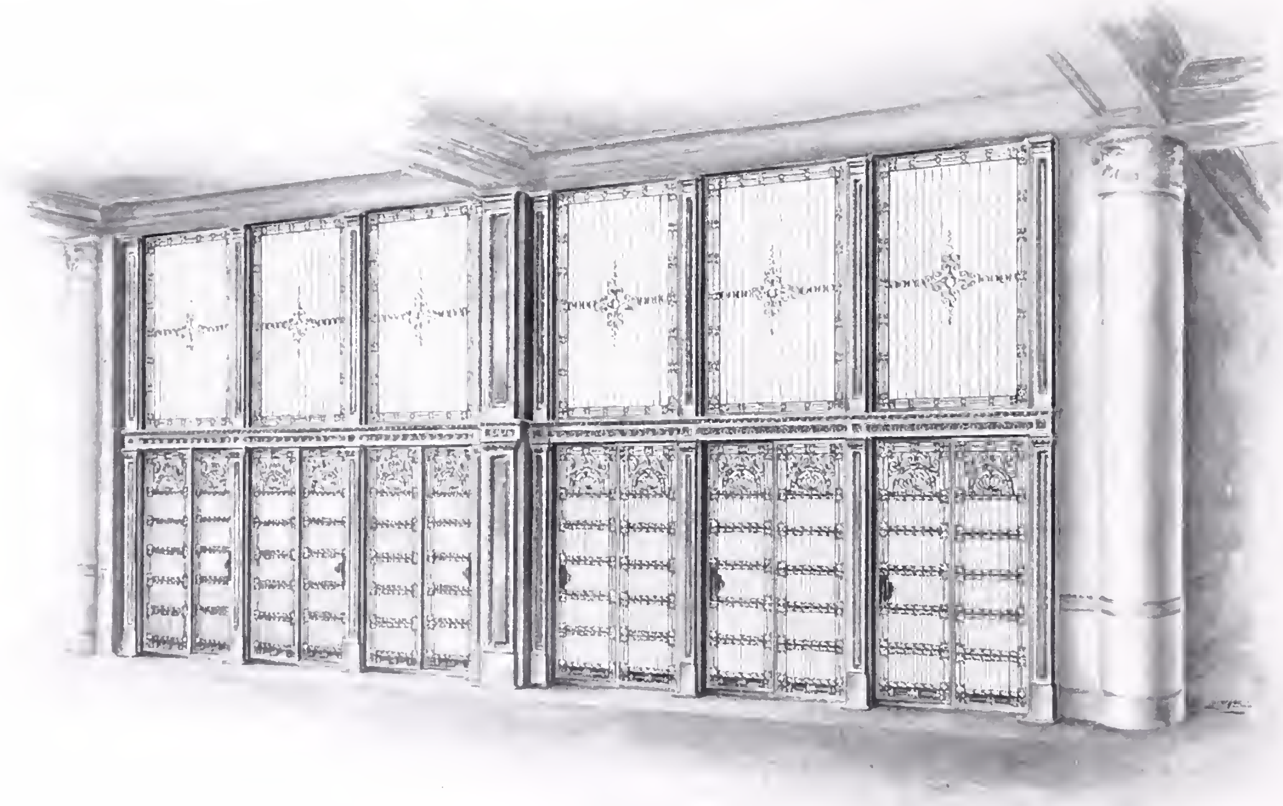


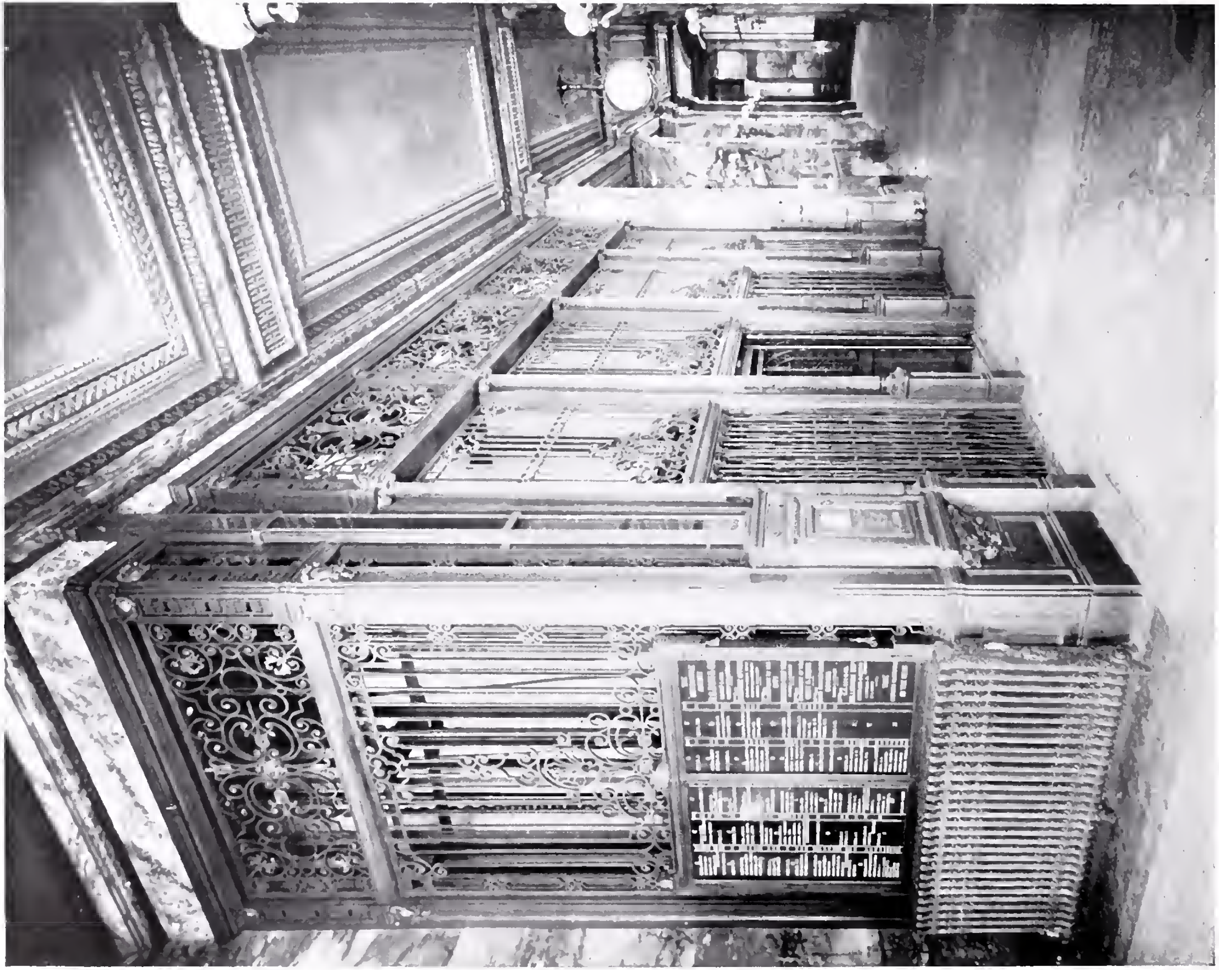
Plate No. 90.



MORGENTHAU BUILDING, 19TH STREET AND SIXTH AVENUE, NEW YORK.

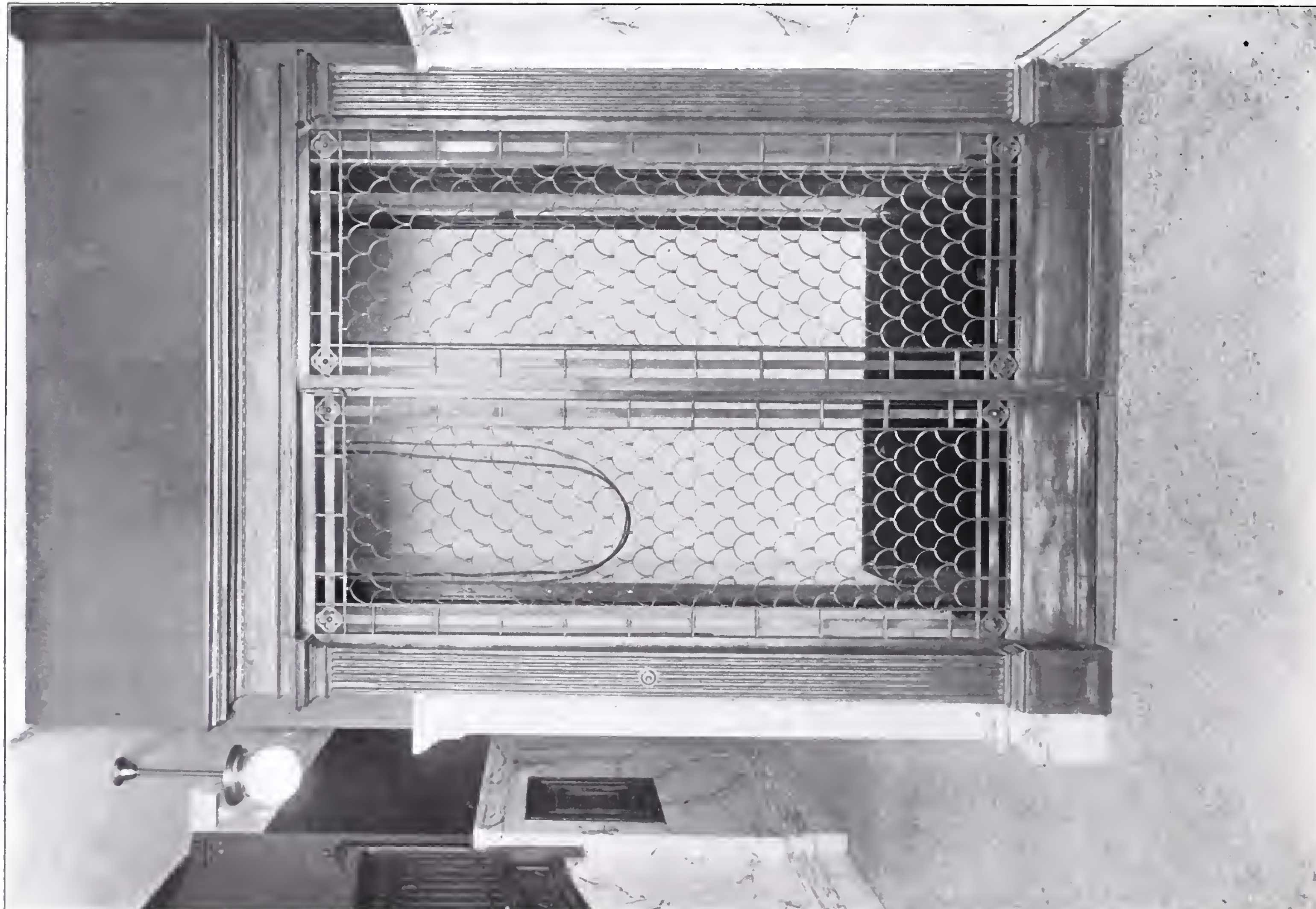
IRON WORK FURNISHED AND ERECTED BY MILLIKEN BROTHERS.

DUN BUILDING, READE STREET AND BROADWAY, NEW YORK.



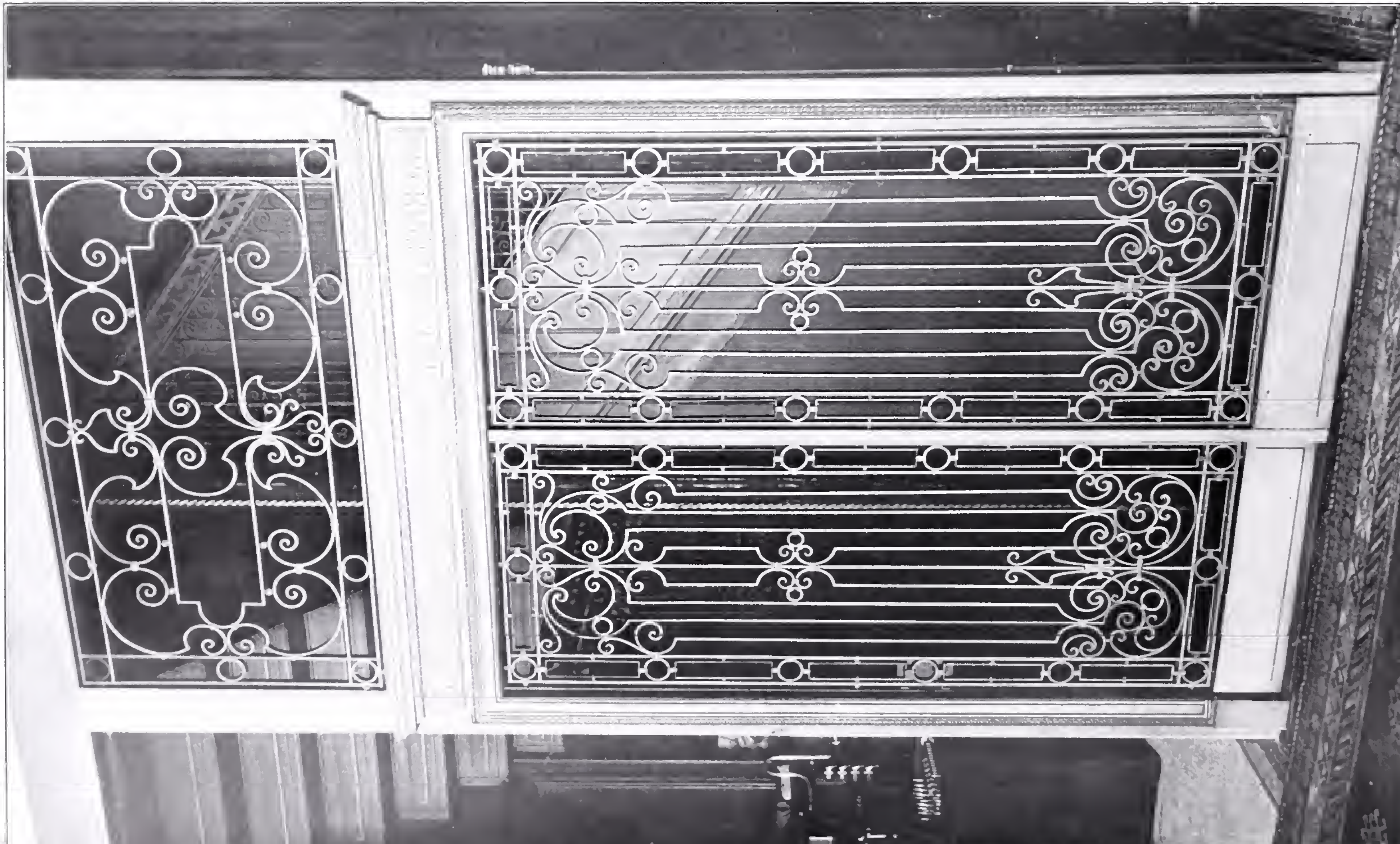
BRONZE WORK FURNISHED AND ERECTED BY MILLIKEN BROTHERS.

WORK DESIGNED, FURNISHED AND ERECTED BY MILLIKEN BROTHERS.



WORK DESIGNED, FURNISHED AND ERECTED BY MILLIKEN BROTHERS.

WORK DESIGNED, FURNISHED AND ERECTED BY MILLIKEN BROTHERS.



WORK DESIGNED, FURNISHED AND ERECTED BY MILLIKEN BROTHERS.

BRONZE WORK FURNISHED AND ERECTED BY MILLIKEN BROTHERS.

ORNAMENTAL SHEET METAL WORK.

Sheet metal work of an ornamental character has come into general use in recent years, to take the place of stone or iron, for cornices, balustrades, consoles, panels, fascias, mouldings and work generally of this nature. This work can be furnished at a low cost and presents a fine architectural appearance.

We show on Plate No. 91 cornices, columns and balustrades, which are all of the purest classic style. The top story of the building, around which the columns are placed, is used as a summer roof garden and is entirely open at the sides but roofed over. In cold weather removable glass partitions are placed behind the columns and balustrades, enclosing the sides. Total height of this work is 18 feet, and it is made entirely of sheet copper supported on iron framework.

We can also furnish material of this character of galvanized iron with zinc ornaments in place of copper. We can furnish cornices of any size and of any thickness, from No. 16 to No. 28 guage, as may be required.

On Plate No. 92 is shown elevation and section of a cornice which we have furnished for a large store building in a foreign country. This cornice is 10 feet high and is made entirely of sheet copper, excepting the inside panels of the fascia, which are filled with marble slabs.

We also furnish sheet copper or galvanized iron ornamental ridging for roofs, hammered metal ceilings, casings and pediments for outside of windows, covering for bay windows, and if desired the entire front of building can be made of sheet metal with any required amount of ornaments.

Plate No. 91.

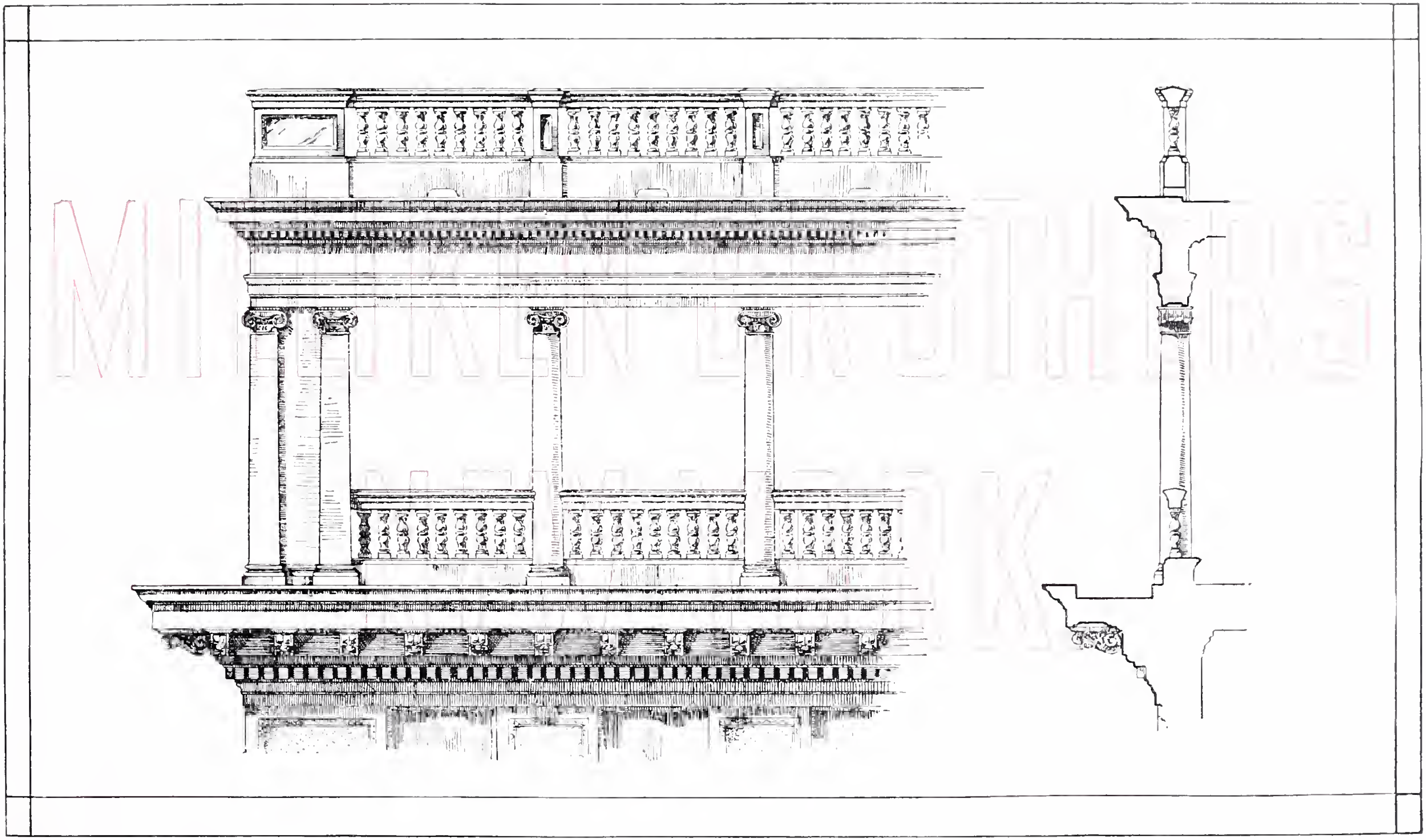
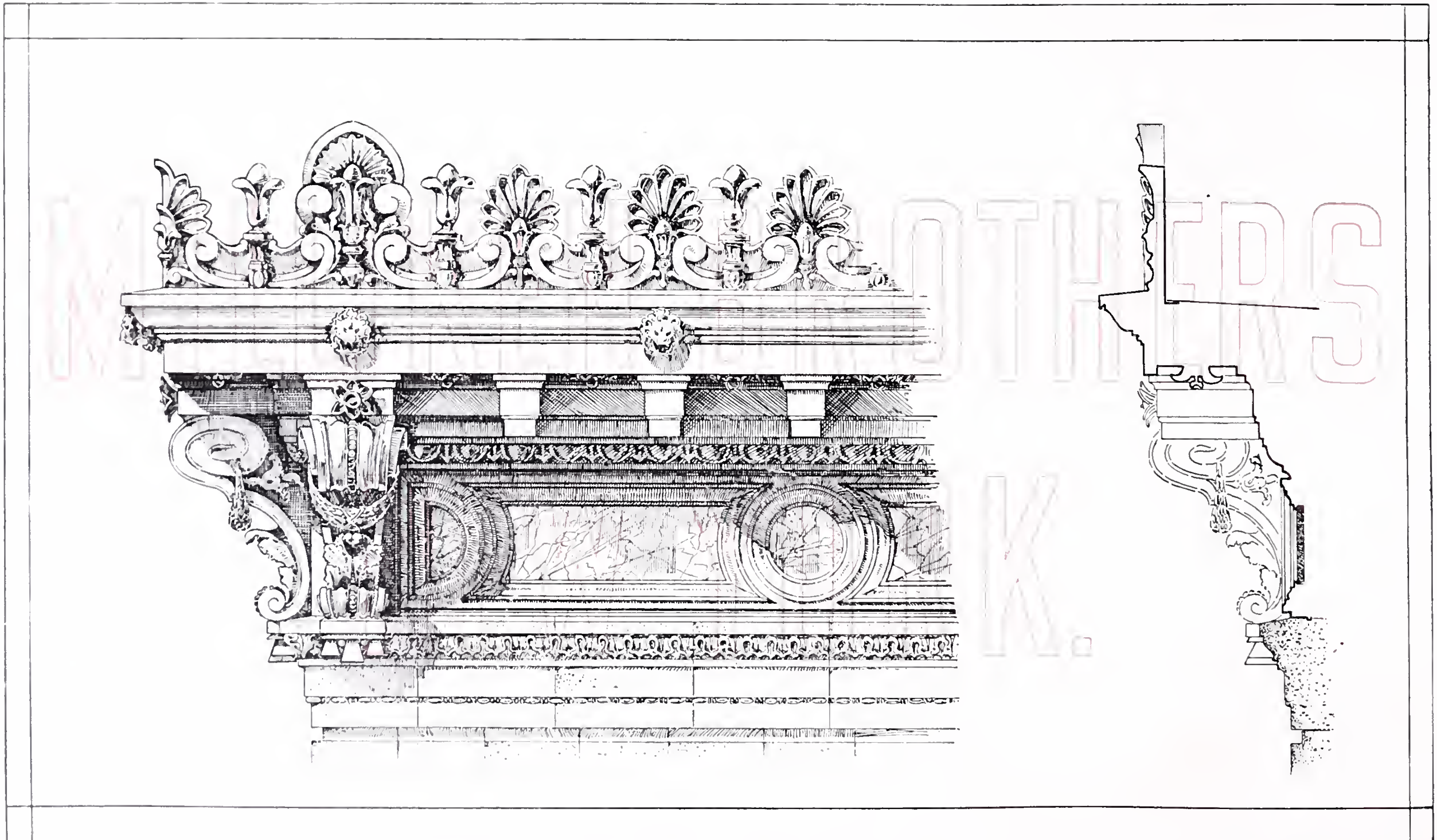


Plate No. 92.



BRONZE BAY WINDOWS, MR. PALMER'S RESIDENCE, WEST 73RD STREET, NEW YORK CITY.

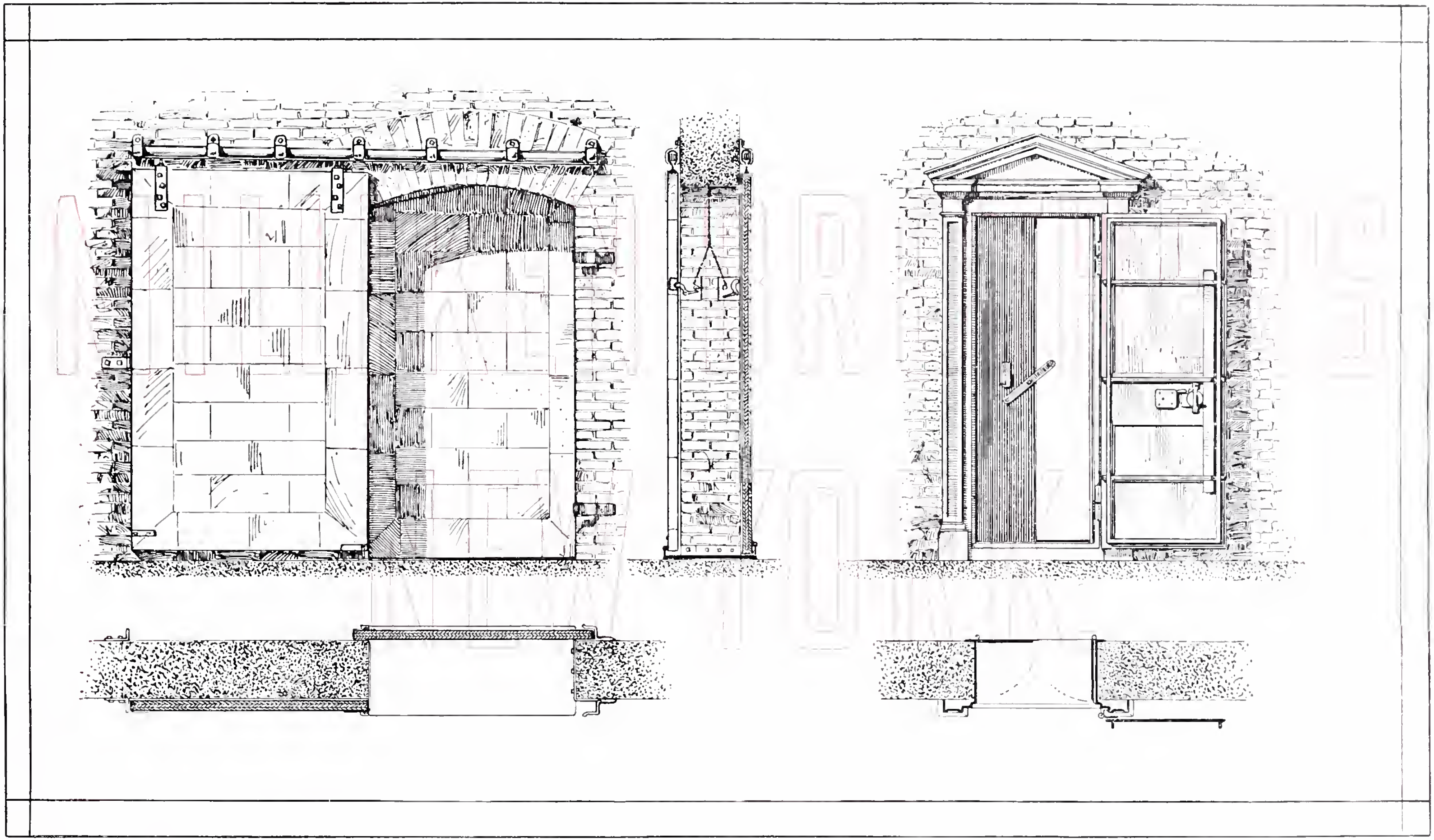
WORK DESIGNED, FURNISHED AND ERECTED BY MILLIKEN BROTHERS.

FIRE PROOF DOORS.

We furnish doors of sheet iron, with or without frames, or of wood covered with tin, galvanized iron or copper; plain or paneled, of any desired size. See Plate No. 93. These doors can be furnished with over-head tracks, fire fuses and complete self-closing attachments so that in case of fire the fuse will burn and the doors will close automatically by their own weight, the tracks being placed on a slight incline. These doors are very serviceable for factory buildings and for doorways between buildings. When the doors connect two buildings, the sills are placed 3 inches above the floor so as to prevent the water going from one building to the other, thus causing damage.

We also furnish Safe Doors, single or double, plain or ornamental, with or without combination locks. On the above Plate we show an elevation and plan of a safe door, the inner door being made in two folds and the outer door in one fold, hung on a cast iron frame. These can be furnished of any width or height desired, and the face of the outer door and frame can be moulded, decorated and painted.

Plate No. 93.

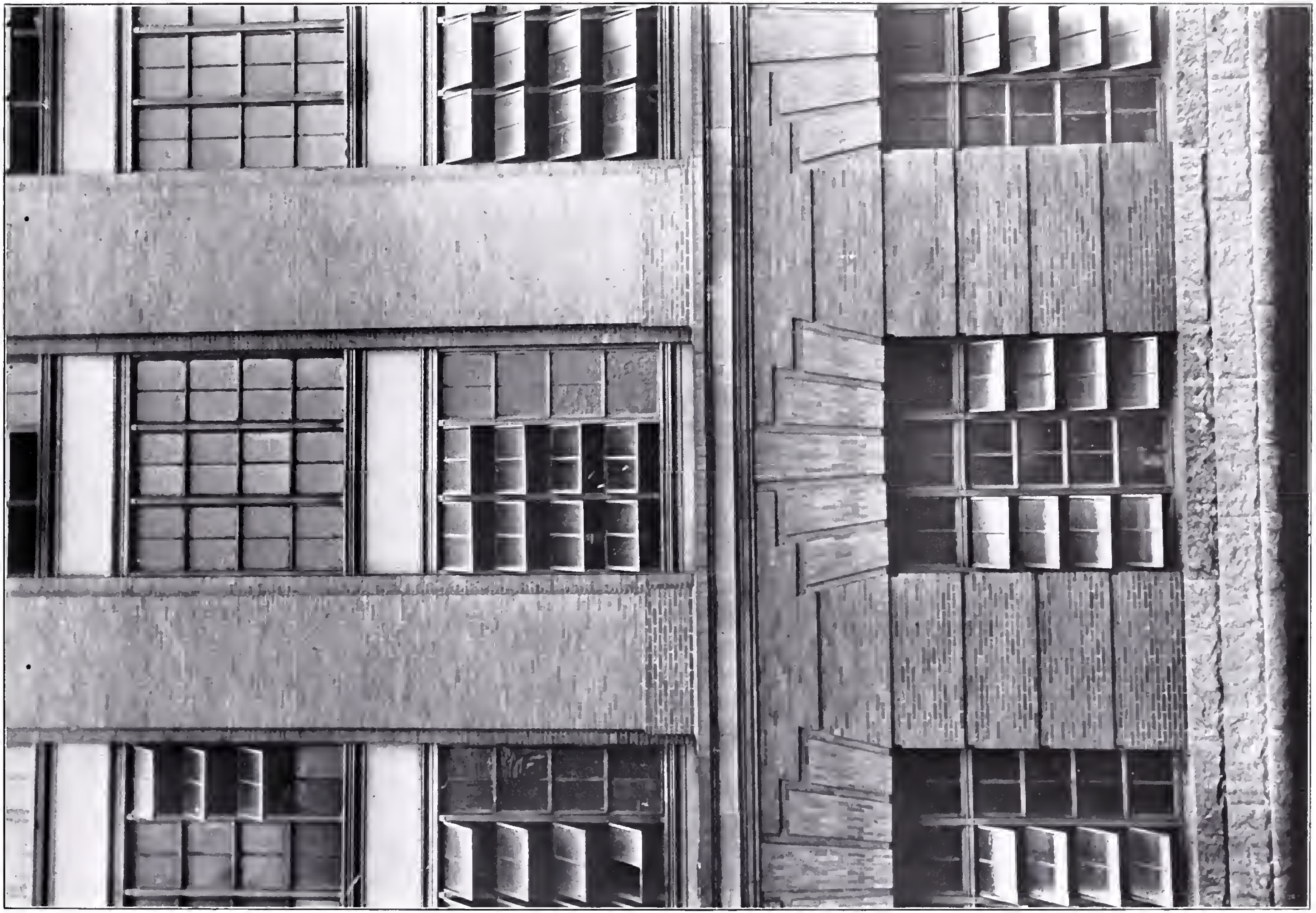


METAL WINDOW SASHES AND FRAMES.

Windows and frames made of metal have largely superseded wood windows for use in factories, office buildings, warehouses, etc., where high fire-proof qualities are desired. The windows can be glazed with plate glass or wire glass (that is, glass fused over a wire mesh fibre) in which case they afford practical fire-proof protection. Metal windows can be made either of wrought or cast iron construction or formed of galvanized sheet iron similar in appearance to wood sash. The sheet metal windows are preferable in cases where it is desired to have the sash double hung, i.e., vertical sliding in pairs with counterbalanced weights. We have a special type of double hung sheet metal window largely used in office buildings which permits the sash to pivot in addition to the vertical sliding motion, thereby enabling the windows to be easily cleaned from the inside. Cast or wrought iron construction affords, of course, the most durable form of window and these are furnished either stationary or with pivots or hinged sash. We have equipped a number of large power houses and factories with these windows both of cast and of wrought iron and they give entire satisfaction. The sashes are usually hinged and pivoted in small sections and the opening and closing may be regulated by a lever arm and gearing on the inside of each window. This operating device can also be arranged so that the windows can be opened in sets as may be desired.

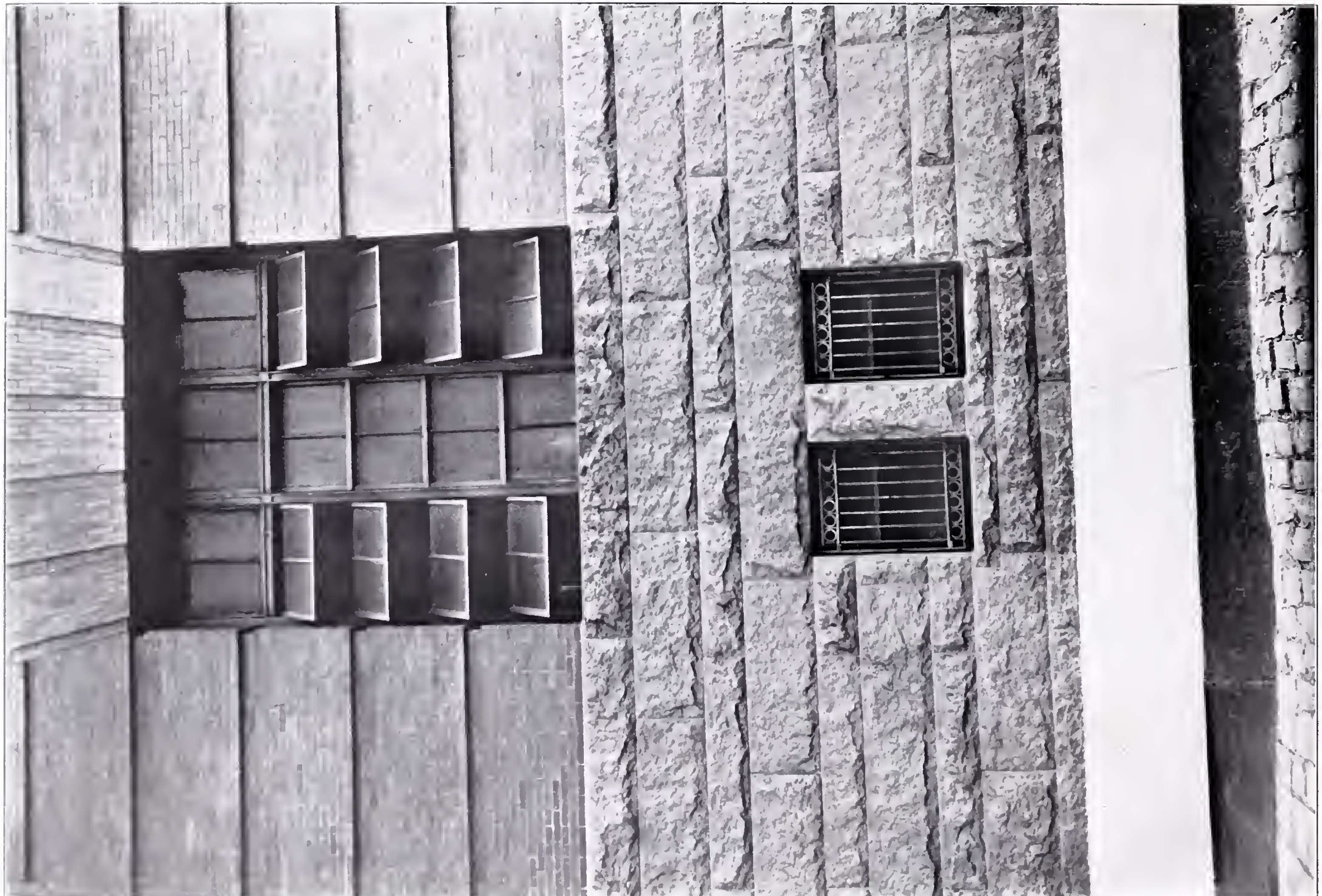
Glass can be furnished either clear, ribbed or wired. Ribbed glass is usually supplied 3/16 inch or 1/4 inch (4.8 m.m. or 6.4 m.m.) thick. Clear glass of double thick American quality about 5/32 inch (4 m.m.) thick. Wire glass 1/4 inch or 5/16 inch (6.4 m.m. or 8 m.m.) thick. The photographs on pages 412 and 413 illustrate some cast iron sash in use.

Iron Windows, "Waterside" Power Station, New York City.



WORK DESIGNED, FURNISHED AND ERECTED BY MILLIKEN BROTHERS.

IRON WINDOWS, "WATERSIDE" POWER STATION, NEW YORK CITY.



WORK DESIGNED, FURNISHED AND ERECTED BY MILLIKEN BROTHERS.

In addition to work described and shown on the preceding pages, we furnish other material, a partial list of which is given below:

Chimney Caps, either of cast iron or steel; plain or ornamental.

Elevators, either passenger or freight, with cars, guides, ropes and machinery for same, either for hydraulic or electric power. Hand power elevators for sidewalks; also dumb waiters.

Fire Escapes of wrought iron, plain or ornamental, for store or factory buildings.

Flag Poles of steel or wood with halliards and fittings complete, including gilded balls and braces.

Gates. Automatic wooden safety gates for front of freight elevators, counter-balanced, self-closing and operated automatically by car.

Gearing and Opening Devices for iron or wooden sashes or transoms.

Gratings of cast or wrought iron for sidewalks and areas; also steel bar or wire gratings for top of elevator shafts to prevent machinery from falling down the shaft.

Guards, either ornamental or plain, of iron, brass or bronze, for windows and doors.

Marble Treads and Platforms for staircases, either of white Italian, grey or white American.

Slate Treads and Platforms for staircases, either black, purple or green.

Shutters for outside of windows, specially adapted for fire protection; can be made either of sheet iron, with or without iron frames, or can be furnished of wood covered with tin.

Shutter Eyes for building into walls to support shutters; can be either painted or galvanized

Saddles or Sills of cast iron, brass or bronze, for entrance doors or elevator doors.

Snow Guards for pitched roofs.

Wheel Guards and Fenders for protection of driveway entrances, either solid cast iron or of wrought iron bars. Also cast iron plain or ornamental fenders or bases, 6 inches to 5 feet in height, for protection of interior columns.

Wire Guards with frames, either painted or galvanized.

Wooden Sash and Frames for windows, including cords, pulleys, weights and glass; also wooden doors and frames, with hardware for same.

Wooden Handrails for staircase railings, either of oak, ash or mahogany.

ORNAMENTAL FIRE ESCAPES, BROOKS BUILDING, NEW YORK CITY.

WORK DESIGNED, FURNISHED AND ERECTED BY MILLIKEN BROTHERS.

CABLE CODE.

In attempting to get up a telegraphic cable code it is quite evident that it is impossible to make such a code as to allow people to order entire buildings or any and every class of material which we furnish that enters into buildings. We have therefore endeavored in the following pages to give simple requests for prices, information, and answers thereto, and also code words representing certain classes of raw material.

It is therefore understood that this code is only partially complete and is intended to be used in connection with Lieber's Standard Code or any of the codes given on cover of this catalogue.

Parties desiring estimates on complete iron structures will therefore be obliged to send in drawings and specifications, or send us such information as will enable us to make up drawings and specifications from which to make estimates on the work in question. At all times, however, we should be very pleased to use this code as far as possible in order to save time, and we expect from time to time to increase this code so as to cover as large a class of information as it is possible to cover in a work of this nature.

It will be noted that we have divided the code under headings. First, phrases embodying information that customers desire us to furnish them with, and immediately following that are phrases in answer to these questions. We believe that this method will help our customers in finding the correct phrases that they wish to use in cabling.

INDEX TO CABLE CODE.

REVERSE INDEX.

1.—Inquiries for Prices, Deliveries, etc.

Code Word.	
Labor	Telegraph lowest net price f. o. b. cars or vessel N. Y. Harbor.
Lace	Telegraph lowest net price and earliest time of delivery f. o. b. cars or vessel N. Y. Harbor.
Lack	At what price will you furnish from stock———
Laconical	Can you reduce your price of———
Laconism	Can you supply additional material at same price?
Lactine	At what price will you supply additional material?
Lading	When could you deliver f. o. b. cars or vessel N. Y. Harbor?
Ladle	Can you make earlier delivery?
Lady	Delivery must be made promptly.
Laird	Delivery may be made at your convenience.
Lamb	How long will you hold price open?
Lame	We cannot allow you to enter order unless you will ship by———
Laminate	We cannot allow you to enter order unless you will reduce your price. We will give you until——— to ship.
Lamp	

ANSWERS TO No. 1.

Code Word.	
Landau	Our lowest price f. o. b. cars or vessel N. Y. Harbor is———
Landloper	In accordance with your letter of———
Landrel	In accordance with your telegram of———
Languor	We can deliver complete in———
Lap	We can furnish complete from stock.
Lapel	We cannot furnish from stock.
Larboard	We cannot reduce our price of———
Larch	We will reduce our price———
Large	We cannot make better delivery.
Lariat	We cannot make estimate from information sent.
Larrup	We will supply additional material at same price.
Lastly	We will supply additional material at———
Lately	We cannot supply the material you ask for.
Latent	We do not make the sizes you ask for. Can furnish———
Latin	Cannot hold price open. Must accept immediately by wire.
Latitude	Will hold price open for———
Latrant	Our lowest price f. o. b. vessel N. Y., or other port at our option with freight and marine insurance prepaid by us to——— is———

2.—Acceptance of our Quotations, etc.

Code Word.	
Laura	We accept your quotation of———
Lava	We cannot accept your quotation of———
Lavcer	Can accept your quotation, if you will deliver in———
Lawsuit	Time of delivery is satisfactory, but prices are too high.
Lawyer	Prices are too high. Can offer you———
Lazily	
Lazy	
Leak	
Leanly	

ANSWERS TO No. 2.

Leap	We accept your order on the terms stated.
Learning	We cannot accept your order on the terms stated.
Leasing	We accept your offer of———
Leaving	We cannot accept your offer of———
Lection	We cannot execute your order until further details are received.
Leeward	
Left	
Legal	
Legality	

3.—Terms of Payment, etc.

Code Word.	
Legation	What terms of payment will you accept?
Lemon	Will arrange satisfactory terms of payment.
Lesion	Net cash on delivery of shipping papers in New York City.
Lethal	Arrange bankers' credit or letter of credit on New York.
Lethean	Advise us name of your agents here who will make payments.
Leveler	Must have payments arranged before we execute your order.
Lever	Your terms of payment are satisfactory.
Levity	Your terms of payment are not satisfactory.
Lexical	
Liable	
Liability	
Liar	

4.—Marking, Freight and Shipping Instructions.

Code Word.	
Libel	Send immediately full marks for material.
Libelous	Send immediately full shipping instructions.
Liberal	Send us name of your shipping agents.
Liberalism	How shall we ship?
Libertine	Are shipping instructions we have correct?
Liberty	Send immediately full marks and shipping instructions.
Libratory	Wire us immediately full marks and shipping instructions. Must have them to make shipment.
Licentious	

ANSWERS TO No. 4.

Lichen	Mark material as follows.
Lickerish	Ship material as follows.
Licorice	Our shipping agents are———
Lictor	Shipping instructions will be given you by———
Lifeboat	Shipping instructions will be given you later.
Lighter	Shipping instructions you have are correct.
Lignite	Mark the goods as follows———, and ship them via———
Likelihood	
Likewise	

5.—Inquiries about Shipments of Orders.

Code Word.	
Liking	Have you shipped order———
Lily	When will you ship order———
Limb	When will you ship balance of order?
Lime	When will you make next shipment?
Limitable	Can you ship order from stock?
Limpsey	
Linden	

ANSWERS TO No. 5.

Link	We have shipped order complete.
Linger	We shipped order complete ———
Lingual	We will ship order complete———
Linguist	We will ship balance of order———
Lining	We will make next shipment———
Linnet	Cannot say when we can make shipment.
Linseed	Cannot ship order from stock.
Linstock	Can ship order from stock.
Lion	Can ship from stock in following sizes.
Lithe	
Litigant	

6.—Shipments delayed—Pieces Lost.

Code Word.	
Litigate	Shipment of——not received.
Litinus	What has delayed shipment of——
Lively	Trace last shipment.
Livid	Shipment of——lost. Please duplicate.
Living	——pieces lost on shipment of——
Lizard	Please duplicate pieces marked——
Loaf	
Loadstone	

ANSWERS TO No. 6.

Local	We will trace shipment——
Logical	We do not know what has delayed shipment——
Logwood	We will duplicate shipment immediately.
Loiterer	We will duplicate lost pieces immediately.
Lombard	We cannot duplicate lost pieces.
Longitude	Send marks of lost pieces and date of shipment.
Longwise	
Loom	

7.—Changing, Suspending and Canceling Orders.

Code Word.	
Loosely	Can we make change in order?
Lovable	Can we change size(s) of material?
Loudly	Change necessary in order.
Lower	Change necessary in size of building.
Lowermost	Order entirely changed. Suspend all work.
Loyal	Order slightly changed. Await further information.
Lubricous	Suspend all work on order.
Lucifer	Suspend work until new details are received.
Lucky	Cancel order of——
Luff	Continue work on order.
Luggage	Change will not be made.
Lugger	
Lull	

ANSWERS TO No. 7.

Lump	We cannot make change in order.
Lunacy	We can make change in order.
Lunation	We cannot make change without additional expense.
Lunch	We can make change without expense.
Lung	Material cut. Too late to make change.
Lure	Have suspended work on order.
Lusory	Have suspended work awaiting new details.
Lyceum	Have canceled order.
Lye	Cannot cancel order.
Lynx	Have continued work on order.
Lyrical	

8.—Names of Articles, Phrases, etc.

Code Word.	
Nadir	Bronze work electroplated.
Naivete	Bronze work solid.
Naked	"Knocked down" for shipment.
Natant	Milliken Patent floor construction.
Naval	Ornamental iron work.
Navy	Painted one shop coat.
Nazarite	Riveted steel girders.
Neap	Riveted steel trusses.
Necessary	Rolling steel shutters.
Nectarial	Sheet iron No. 10.
Needful	Sheet iron No. 12.
Negotiable	Sheet iron No. 14.
Negus	Sheet iron No. 16.
Neither	Sheet iron No. 18.
Nephew	Sheet iron No. 20.
Neuter	Sheet iron No. 22.
Newfangled	Sheet iron No. 24.
Newspaper	Sheet iron No. 26.
Nighness	Sheet iron No. 28.
Nightly	Corrugations 1¼ inches wide.

Code Word.	
Nitrate	Corrugations 2½ inches wide.
Nocuous	Corrugations 3 inches wide.
Noggin	Corrugations 5 inches wide.
Nomad	Galvanized—not painted.
Nonelect	Galvanized and painted.
Nothing	Black—not painted.
Nothurt	Black and painted.
Notional	Smoke stack self supporting.
Novel	Smoke stack guyed.
Numerous	Structural steel work.
Nun	
Nut	
Nutria	
Nymph	
Oak	
Oar	
Oats	
Oblige	
Obsequious	
Obtainable	

Steel Angles.

EQUAL LEGS.			UNEQUAL LEGS.		
Code Word.	Size in inches.	Size in millimetres.	Code Word.	Size in inches.	Size in millimetres.
Aback	6 x 6	152.39 x 152.39	*Adaptable*	7 x 3½	177.79 x 88.89
Abacus	5 x 5	126.99 x 126.99	*Adjacent*	6 x 4	152.39 x 101.59
Abaft	4 x 4	101.59 x 101.59	*Adjoin*	6 x 3½	152.39 x 88.89
Abasing	3½ x 3½	88.89 x 88.89	*Adjutor*	5 x 3½	126.99 x 88.89
Abatement	3 x 3	76.19 x 76.19	*Admissible*	5 x 3	126.99 x 76.19
Abbettor	2½ x 2½	63.49 x 63.49	*Adobelt*	4 x 3	101.59 x 76.19
Abolish	2¼ x 2¼	57.14 x 57.14	*Adopt*	3½ x 3	88.89 x 76.19
Above	2 x 2	50.79 x 50.79	*Adoption*	3½ x 2½	88.89 x 63.49
Abreast	1¾ x 1¾	44.44 x 44.44	*Advance*	3 x 2½	76.19 x 63.49
Absence	1½ x 1½	38.09 x 38.09	*Advantage*	3 x 2	76.19 x 50.79
Abundant	1¼ x 1¼	31.74 x 31.74	*Advisably*	2½ x 2	63.49 x 50.79
Abuse	1 x 1	25.4 x 25.4	*Affix*	2 x 1½	50.79 x 38.09

See table for thickness farther on.

Steel I Beams.

Code Word.	Depth in inches.	Weight per foot in pounds.	Depth in milli-metres.	Weight per metre in kilograms.
Baby	24	100	609.58	148.82
Bacon	24	95	609.58	141.38
Bad	24	90	609.58	133.93
Baggage	24	85	609.58	126.49
Bagniol	24	80	609.58	119.05
Bailable	20	100	507.99	148.82
Bailee	20	95	507.99	141.38
Bailing	20	90	507.99	133.93
Bakeman	20	85	507.99	126.49
Bald	20	80	507.99	119.05
Baldrick	20	75	507.99	111.61
Ball	20	70	507.99	104.17
Ballister	20	65	507.99	96.73
Ballooning	18	70	457.19	104.17
Ballotry	18	65	457.19	96.73
Bamboo	18	60	457.19	89.29
Bambust	18	55	457.19	81.85
Banana	15	100	380.99	148.82
Bandogert	15	95	380.99	141.38
Bandoling	15	90	380.99	133.93
Bang	15	85	380.99	126.49
Bankable	15	80	380.99	119.05
Bankbook	15	75	380.99	111.61

Code Word.	Depth in inches.	Weight per foot in pounds.	Depth in milli-metres.	Weight per metre in kilograms.
Bans	15	70	380.99	104.17
Barberied	15	65	380.99	96.73
Barefaced	15	60	380.99	89.29
Barge	15	55	380.99	81.85
Bark	15	50	380.99	74.41
Barley	15	45	380.99	66.96
Barleybarn	15	40	380.99	62.50
Barmy	12	55	304.79	81.85
Barn	12	50	304.79	74.41
Barouche	12	45	304.79	66.96
Barrel	12	40	304.79	59.52
Barren	12	35	304.79	52.08
Basesel	12	31.5	304.79	46.87
Bassoon	10	40	253.99	59.52
Bastiled	10	35	253.99	52.08
Bateau	10	30	253.99	44.64
Bayou	10	25	253.99	37.20
Beautifier	9	35	228.59	52.08
Beeame	9	30	228.59	44.64
Because	9	25	228.59	37.20
Bed	9	21	228.59	31.25
Bedazzer	8	25.5	203.19	37.94
Bedfellow	8	23	203.19	34.22

Steel I Beams—*Continued.*

Code Word.	Depth in inches.	Weight per foot in pounds.	Depth in milli-metres.	Weight per metre in kilograms.	Code Word.	Depth in inches.	Weight per foot in pounds.	Depth in milli-metres.	Weight per metre in kilograms.
Bedim	8	20.5	203.19	30.50	*Behalf*	5	12.25	126.99	18.23
Bedraggle	8	18	203.19	26.78	*Belhanger*	5	9.75	126.99	14.51
Bedrest	7	20	177.79	29.76	*Bell*	4	10.5	101.59	15.62
Bedroom	7	17.5	177.79	26.04	*Belong*	4	9.5	101.59	14.13
Beef	7	15	177.79	22.32	*Below*	4	8.5	101.59	12.64
Beeves	6	17.25	152.39	25.67	*Bemoned*	4	7.5	101.59	11.16
Befall	6	14.75	152.39	21.95	*Berating*	3	7.5	76.19	11.16
Before	6	12.25	152.39	18.23	*Berry*	3	6.5	76.19	9.67
Begin	5	14.75	126.99	21.95	*Berth*	3	5.5	76.19	8.18

Steel Bulb Angles.

Code Word.	Depth in inches.	Weight per foot in pounds.	Depth in milli-metres.	Weight per metre in kilograms.	Code Word.	Depth in inches.	Weight per foot in pounds.	Depth in milli-metres.	Weight per metre in kilograms.
Beset	10	26.5	253.99	39.43	*Bespeak*	6	17.20	152.39	25.59
Besettle	9	21.8	228.59	32.44	*Bespread*	6	13.75	152.39	20.45
Besides	8	19.23	203.19	28.6	*Betake*	6	12.30	152.39	18.3
Bespanment	7	18.25	177.79	27.15	*Bethink*	5	10.0	126.99	14.88

Steel Zee Bars.

Code Word	Depth in inches.	Depth in millimetres.	Code Word	Depth in inches.	Depth in millimetres.
Betimes	6	152.39	*Between*	4	101.59
Betterment	5	126.99	*Bibulistic*	3	76.19

See table for thickness farther on.

Steel Deck Beams.

Code Word.	Depth in inches.	Weight per foot in pounds.	Depth in milli-metres.	Weight per metre in kilograms.	Code Word.	Depth in inches.	Weight per foot in pounds.	Depth in milli-metres.	Weight per metre in kilograms.
Dale	10	35.7	253.99	53.13	*Data*	8	20.15	203.19	30.0
Danger	10	27.23	253.99	40.6	*Daub*	7	23.46	177.79	34.8
Dare	9	30.0	228.59	44.6	*Daunt*	7	18.11	177.79	26.9
Darnel	9	26.0	228.59	38.7	*Davit*	6	18.36	152.39	27.3
Dash	8	24.48	203.19	36.4	*Dead*	6	15.30	152.39	22.7

Phœnix Columns.

Gaily	4-A Segments.	*Gambling*	4-C Segments.
Gallic	4-B1 Segments.	*Gamboge*	6-E Segments.
Galoche	4-B2 Segments.	*Gamut*	8-G Segments.

See table for thickness farther on.

Steel Channels.

	Depth in inches.	Weight per foot in pounds.	Depth in milli-metres.	Weight per metre in kilograms.		Depth in inches.	Weight per foot in pounds.	Depth in milli-metres.	Weight per metre in kilograms.
Cabal	15	55	380.99	81.85	*Cachou*	15	33	380.99	49.11
Cabin	15	50	380.99	74.41	*Calash*	12	40	304.79	59.52
Caboose	15	45	380.99	66.96	*Calefurn*	12	35	304.79	52.08
Caburt	15	40	380.99	59.52	*Calends*	12	30	304.79	44.64
Cachery	15	35	380.99	52.08	*Calf*	12	25	304.79	37.20

Steel Channels—*Continued.*

Code Word.	Depth in inches.	Weight per foot in pounds.	Depth in millimetres.	Weight per metre in kilograms.
Calker	12	20.5	304.79	30.50
Calling	10	35	253.99	52.08
Camel	10	30	253.99	44.64
Camphoring	10	25	253.99	37.20
Candidly	10	20	253.99	29.76
Candle	10	15	253.99	22.32
Cankerous	9	25	228.59	37.20
Canopy	9	20	228.59	29.76
Canorosity	9	15	228.59	22.32
Canton	9	13.25	228.59	19.71
Cap	8	21.25	203.19	31.62
Capable	8	18.75	203.19	27.90
Capsize	8	16.25	203.19	24.18
Capstan	8	13.75	203.19	20.46
Captain	8	11.25	203.19	16.75
Capturyst	7	19.75	177.79	29.39
Carafe	7	17.25	177.79	25.67
Card	7	14.75	177.79	21.94
Carder	7	12.25	177.79	18.22
Caress	7	9.75	177.79	14.50
Cargo	6	15.50	152.39	23.06
Carmot	6	13	152.39	19.34
Carnai	6	10.50	152.39	15.62
Carnalist	6	8	152.39	11.9
Carnally	5	11.5	126.99	17.11
Carp	5	9	126.99	13.39
Carpet	5	6.5	126.99	9.67
Carry	4	7.25	101.59	10.78
Carrot	4	6.25	101.59	9.30
Cartage	4	5.25	101.59	7.81
Cartridge	3	6	76.19	8.92
Case	3	5	76.19	7.44
Casehardcn	3	4	76.19	5.95

Steel Tees.

EQUAL LEGS.			UNEQUAL LEGS.		
Code Word.	Size in inches.	Size in millimetres.	Code Word.	Size in inches.	Size in millimetres.
Tabid	4 x 4	101.59 x 101.59	*Tamper*	4 x 5	101.59 x 126.99
Tableau	3½ x 3½	88.89 x 88.89	*Tampion*	4 x 3	101.59 x 76.19
Tackling	3 x 3	76.19 x 76.19	*Tan*	3½ x 4	88.89 x 101.59
Tactics	2½ x 2½	63.49 x 63.49	*Tapioca*	3½ x 3	88.89 x 76.19
Taffrail	2¼ x 2¼	57.14 x 57.14	*Taproom*	3 x 4	76.19 x 101.59
Taint	2 x 2	50.79 x 50.79	*Tariff*	3 x 2½	76.19 x 63.49
Tale	1¾ x 1¾	44.44 x 44.44	*Tarish*	3 x 3½	76.19 x 88.89
Talent	1½ x 1½	38.09 x 38.09	*Tarpaulin*	2½ x 3	63.49 x 76.19
Tallow	1¼ x 1¼	31.70 x 31.70	*Tarry*	2½ x 2¾	63.49 x 69.84
Tallyman	1 x 1	25.40 x 25.40	*Tassel*	1¾ x 1¼	44.44 x 31.74

See table for thickness farther on.

Words for Ordering Flats and Plates.

Sizes one inch and under use words given in table farther on headed "Thickness of Metal."

WIDTHS.			WIDTHS.			WIDTHS.			WIDTHS.		
Code Word.	Inches.	Millimetres.	Code Word.	Inches.	Millimetres.	Code Word.	Inches.	Millimetres.	Code Word.	Inches.	Millimetres.
Wade	1⅛	28.56	*Waive*	2¼	57.14	*Wanness*	3¾	95.24	*Watch*	7	177.79
Waft	1¼	31.74	*Wall*	2½	63.49	*Warehouse*	4	101.59	*Watcher*	8	203.19
Wages	1½	38.09	*Walleye*	2¾	69.84	*Wares*	4¼	107.94	*Water*	9	228.59
Wagon	1⅝	41.27	*Wallop*	3	76.19	*Warm*	4½	114.29	*Watermelon*	10	253.99
Wain	1¾	44.44	*Wampum*	3¼	82.54	*Warranty*	5	126.99	*Waver*	11	279.39
Waist	2	50.79	*Wan*	3½	88.89	*Wash*	6	152.39	*Weaken*	12	304.79

Words for Ordering Flats and Plates—*Continued.*

WIDTHS.			WIDTHS.			WIDTHS.			WIDTHS.		
Code Word.	Inches.	Milli-metres.	Code Word.	Inches.	Milli-metres.	Code Word.	Inches.	Milli-metres.	Code Word.	Inches.	Milli-metres.
Wealth	13	330.19	*Wellbeing*	19	482.59	*Wharf*	30	761.98	*Whinny*	60	1523.97
Weasand	14	355.59	*Westerly*	20	507.99	*Wharfage*	35	888.98	*Whiten*	66	1676.37
Weather	15	380.99	*Westward*	21	532.38	*Whatsoever*	40	1015.98	*Wholesale*	72	1828.77
Weed	16	406.39	*Westy*	22	558.79	*Whenever*	45	1142.98	*Wider*	78	1981.16
Weekday	17	431.79	*Wex*	23	584.18	*Whereat*	50	1269.97	*Widespread*	84	2133.56
Weigh	18	457.19	*Whaleman*	24	609.58	*Wherefore*	55	1396.97			

Round and Square Steel Bars.

Code Word. Rounds.	Code Word. Squares.	Size in inches.	Size in millimetres.
Raccoon	*Sachem*	3/8	9.52
Radial	*Sage*	7-16	11.11
Radiator	*Sagittal*	1/2	12.69
Radix	*Sailloft*	9-16	14.28
Raging	*Sailor*	5/8	15.87
Rags	*Sake*	11-16	17.46
Railway	*Salaceous*	3/4	19.04
Raimbolt	*Salamagen*	13-16	20.63
Raise	*Saleable*	7/8	22.22
Rake	*Sallow*	15-16	23.80
Rammer	*Salt*	1	25.39
Ramons	*Saltern*	1 1/8	28.56
Ransomer	*Saltpetre*	1 3-16	30.15
Ransomless	*Same*	1 1/4	31.74
Rap		1 5-16	33.32
Rapidly	*Sanhedrin*	1 3/8	34.91
Rapine		1 7-16	36.50
Rasure	*Sapor*	1 1/2	38.09
Ratan		1 5/8	41.27
Rate	*Saporific*	1 3/4	44.44
Rather		1 7/8	47.62
Ratling	*Saturn*	2	50.79
Ratoon	*Saturine*	2 1/8	53.97
Raucity	*Savable*	2 1/4	57.14

Round and Square Steel Bars—*Continued.*

Code Word. Rounds.	Code Word. Squares.	Size in inches.	Size in millimetres.
Ravesty	*Scannel*	2⅜	60.32
Ravish	*Scanron*	2½	63.49
Ravishment	*Scarce*	2⅝	66.67
Rawhead	*Schemer*	2¾	69.84
Razor	*Schoolman*	2⅞	73.02
Reaction	*Schooner*	3	76.19
Readily		3⅛	79.37
Readjust	*Scraggy*	3¼	82.54
Readmit		3⅜	85.72
Reannex	*Scrutoir*	3½	88.89
Reappoint		3⅝	92.07
Rearguard	*Scupper*	3¾	95.24
Reason		3⅞	98.42
Reasonable	*Secederal*	4	101.59
Reassert		4⅛	104.77
Reassign	*Seclant*	4¼	107.94
Reassure		4⅜	111.12
Rebaptist	*Seemart*	4½	114.29
Rebel		4⅝	117.47
Rebellion	*Second*	4¾	120.64
Recapture		4⅞	123.82
Receivable		5	126.99
Receiver		5¼	133.34
Recency		5½	139.69
Recentness		5¾	146.04
Reheat		6	152.39
Rechoose		6¼	158.74
Recognize		6½	165.09
Recollect		6¾	171.44

Length in Feet.

Code Word		Code Word.		Code Word.		Code Word.		Code Word.	
Facet	1	*Fagend*	6	*Faldstool*	11	*Family*	16	*Fangless*	21
Facing	2	*Failure*	7	*Fall*	12	*Famine*	17	*Fare*	22
Facsimile	3	*Faintish*	8	*Falsely*	13	*Fan*	18	*Faring*	23
Fact	4	*Fair*	9	*Falter*	14	*Fancy*	19	*Farmer*	24
Factionist	5	*Faith*	10	*Famed*	15	*Fang*	20	*Farrago*	25

Length in Feet—*Continued.*

Code Word.		Code Word.		Code Word.		Code Word.		Code Word.	
Farrier	26	*Fathomless*	36	*Felony*	46	*Fewness*	55	*Filings*	64
Farrow	27	*Fatness*	37	*Fencing*	47	*Fiat*	56	*Filthily*	65
Farthing	28	*Faulty*	38	*Fenian*	48	*Fibber*	57	*Financier*	66
Fascicular	29	*Fauny*	39	*Ferreous*	49	*Fieriness*	58	*Fineness*	67
Fascinity	30	*Favor*	40	*Fertile*	50	*Fifer*	59	*Finisher*	68
Fastday	31	*Favorable*	41	*Fervency*	51	*Figilate*	60	*Firelock*	69
Fasten	32	*Fearful*	42	*Fervidly*	52	*Figment*	61	*Firmly*	70
Fatal	33	*Feastful*	43	*Fetid*	53	*Filiation*	62	*Firmness*	71
Fated	34	*Fedition*	44	*Feudalism*	54	*Filigree*	63	*Fishing*	72
Fathom	35	*Feeder*	45						

Length in Inches.

Ibex	1/8	*Imaginable*	1 1/2	*Implacable*	2 7/8	*Improbable*	4 1/4	*Incisure*	5 5/8
Iceberg	1/4	*Imagine*	1 5/8	*Implead*	3	*Improper*	4 3/8	*Incitant*	5 3/4
Iciness	3/8	*Imbosom*	1 3/4	*Implex*	3 1/8	*Improve*	4 1/2	*Incite*	5 7/8
Ignescent	1/2	*Immaterial*	1 7/8	*Implicit*	3 1/4	*Impure*	4 5/8	*Inclasp*	6
Igniferous	5/8	*Immigrate*	2	*Impolite*	3 3/8	*Impurity*	4 3/4	*Inclose*	6 1/8
Illiberal	3/4	*Immoderate*	2 1/8	*Imporous*	3 1/2	*Inaction*	4 7/8	*Inclusion*	6 1/4
Illicit	7/8	*Immovable*	2 1/4	*Import*	3 5/8	*Inadequate*	5	*Income*	6 3/8
Illnature	1	*Impanel*	2 3/8	*Impregnate*	3 3/4	*Inane*	5 1/8	*Incurious*	6 1/2
Illogical	1 1/8	*Impassive*	2 1/2	*Imprimis*	3 7/8	*Inaposite*	5 1/4	*Indecent*	6 5/8
Illstarred	1 1/4	*Impawn*	2 5/8	*Imprint*	4	*Inapt*	5 3/8	*Indeed*	6 3/4
Illwill	1 3/8	*Impersonal*	2 3/4	*Imprison*	4 1/8	*Inarch*	5 1/2	*Index*	6 7/8

Length in Inches—*Continued.*

Code Word.		Code Word.		Code Word.		Code Word.		Code Word.	
Indian	7	*Inertia*	8⅛	*Infold*	9⅛	*Inkiness*	10⅛	*Insnare*	11⅛
Indicate	7⅛	*Inertness*	8¼	*Inform*	9¼	*Inland*	10¼	*Insolvent*	11¼
Indorse	7¼	*Infamy*	8⅜	*Infuse*	9⅜	*Inlet*	10⅜	*Inspire*	11⅜
Indue	7⅜	*Infant*	8½	*Ingot*	9½	*Inmost*	10½	*Instance*	11½
Inebriate	7½	*Infer*	8⅝	*Ingulf*	9⅝	*Inning*	10⅝	*Instead*	11⅝
Inedited	7⅝	*Inferior*	8¾	*Inhere*	9¾	*Insecure*	10¾	*Insurable*	11¾
Ineffective	7¾	*Infernal*	8⅞	*Injure*	9⅞	*Inside*	10⅞	*Insurance*	11⅞
Ineligible	7⅞	*Infix*	9	*Ink*	10	*Insist*	11	*Insure*	12
Inequality	8								

Length in Metres.

Machinery	1	*Makebate*	7	*Manifest*	13	*Maranatha*	19	*Marshy*	25
Madrepore	2	*Mallard*	8	*Manlike*	14	*Marcid*	20	*Martinman*	26
Magi	3	*Mallows*	9	*Mantua*	15	*Marital*	21	*Masonic*	27
Mahogany	4	*Malmsey*	10	*Manurial*	16	*Marlant*	22	*Mayday*	28
Mainmast	5	*Manage*	11	*Maple*	17	*Marline*	23	*Mazarine*	29
Major	6	*Mangle*	12	*Mappery*	18	*Marmorean*	24	*Meaning*	30

Decimal Parts of a Metre.

Code Word.		Code Word.		Code Word.		Code Word.		Code Word.	
Measly	.100	*Mediation*	.700	*Melody*	.040	*Mend*	.090	*Mesh*	.005
Measure	.200	*Mediator*	.800	*Melon*	.050	*Menhaden*	.001	*Methodical*	.006
Meat	.300	*Meed*	.900	*Memorable*	.060	*Merchant*	.002	*Metropolis*	.007
Mechanism	.400	*Melee*	.010	*Memorandum*	.070	*Mercy*	.003	*Mew*	.008
Mechanist	.500	*Melodeon*	.020	*Memorize*	.080	*Merriest*	.004	*Mezzo*	.009
Medal	.600	*Melodrama*	.030						

Thickness of Metal.

	In inches.	In millimetres.		In inches.	In millimetres.		In inches.	In millimetres.
Earnings	1/8	3.17	*Eaves*	7-16	11.11	*Edyction*	3/4	19.05
Earthtank	3-16	4.76	*Ebrition*	1/2	12.7	*Effective*	13-16	20.63
Eastern	1/4	6.34	*Edgeman*	9-16	14.28	*Effectual*	7/8	22.22
Eastward	5-16	7.93	*Edging*	5/8	15.87	*Egression*	15-16	23.81
Easy	3/8	9.52	*Edomant*	11-16	17.46	*Egrette*	1 0-0	25.4

For Weights in Pounds and Decimal Parts of a Pound only.

Code Word.		Code Word.		Code Word.		Code Word.		Code Word.	
Habeas	1.00	*Hair*	7.00	*Handbill*	.30	*Hardhack*	.90	*Harrow*	.05
Habitable	2.00	*Hallow*	8.00	*Handcuff*	.40	*Hardy*	.01	*Harvest*	.06
Habitual	3.00	*Halo*	9.00	*Handier*	.50	*Harmonica*	.02	*Hash*	.07
Hades	4.00	*Halter*	0.00	*Hank*	.60	*Harmonious*	.03	*Haste*	.08
Haft	5.00	*Halyard*	.10	*Happier*	.70	*Harness*	.04	*Hatchet*	.09
Hail	6.00	*Hammock*	.20	*Harbor*	.80				

For Weights in Kilograms and Decimal Parts of a Kilogram only.

Hatchway	1.00	*Hawker*	7.00	*Headway*	.30	*Heath*	.90	*Heirloom*	.05
Hatter	2.00	*Hazardous*	8.00	*Healthily*	.40	*Hector*	.01	*Helter*	.06
Haunch	3.00	*Hazel*	9.00	*Healthier*	.50	*Hedgehog*	.02	*Hemstich*	.07
Hauteur	4.00	*Headstall*	0.00	*Hearsay*	.60	*Heifer*	.03	*Hemlock*	.08
Haven	5.00	*Headstone*	.10	*Hearse*	.70	*Heinous*	.04	*Henceforth*	.09
Havoc	6.00	*Headstrong*	.20	*Heartless*	.80				

Prices—U. S. A.

Code Word.	Price per pound in cents.	Price per kilo in cents.	Code Word.	Price per pound in cents.	Price per kilo in cents.	Code Word.	Price per pound in cents.	Price per kilo in cents.
Pacha	1-10	.22	*Payment*	1 4-10	3.08	*Pickpocket*	2.55	5.61
Package	1/8	.275	*Peace*	1 1/2	3.30	*Pilot*	2 6-10	5.72
Palatine	2-10	.44	*Pegasus*	1 6-10	3.52	*Pilotage*	2 5/8	5.775
Palliasse	1/4	.55	*Pelicle*	1 5/8	3.575	*Pinch*	2.65	5.83
Pallid	3-10	.66	*Pelisse*	1 7-10	3.74	*Pine*	2 7-10	5.94
Pandect	3/8	.825	*Penknife*	1 3/4	3.85	*Pirate*	2 3/4	6.05
Pantalets	4-10	.88	*Pentagraph*	1 8-10	3.96	*Piratical*	2 8-10	6.16
Pantaloons	1/2	1.10	*Peony*	1 7/8	4.125	*Pitchpipe*	2.85	6.27
Pantheist	6-10	1.32	*Percentage*	1 9-10	4.18	*Pitiless*	2 7/8	6.325
Panther	5/8	1.375	*Perhaps*	2	4.4	*Placeman*	2 9-10	6.38
Papacy	7-10	1.54	*Periman*	2.05	4.51	*Plague*	2.95	6.49
Papyrus	3/4	1.65	*Peristyle*	2 1-10	4.62	*Plainly*	3	6.6
Paradise	8-10	1.76	*Perjure*	2 1/8	4.675	*Plaintiff*	3.05	6.71
Parallax	7/8	1.925	*Petition*	2.15	4.73	*Plan*	3 1-10	6.82
Parasol	9-10	1.98	*Petrolium*	2 2-10	4.84	*Plantain*	3 1/8	6.875
Parcel	1	2.2	*Phaeton*	2.25	4.95	*Planticle*	3.15	6.93
Parentless	1 1-10	2.42	*Pharisee*	2 3-10	5.06	*Plasmatic*	3 2-10	7.04
Parliament	1 1/8	2.475	*Philippic*	2.35	5.17	*Plateau*	3.25	7.15
Passbook	1 2-10	2.64	*Philomel*	2 3/8	5.225	*Platitude*	3 3-10	7.26
Passenger	1 1/4	2.75	*Phosphoric*	2 4-10	5.28	*Platonic*	3.35	7.37
Passport	1 3-10	2.86	*Photogen*	2.45	5.39	*Platter*	3 3/8	7.425
Payable	1 3/8	3.025	*Piantic*	2 1/2	5.5	*Playfellow*	3 4-10	7.48

Code Word.	Price per pound in cents.	Price per kilo in cents.	Code Word.	Price per pound in cents.	Price per kilo in cents.	Code Word.	Price per pound in cents.	Price per kilo in cents.
Pleonastic	3.45	7.59	*Pomp*	4⅜	9.625	*Postmark*	5 3-10	11.66
Plexiform	3½	7.7	*Ponder*	4 4-10	9.68	*Postpone*	5.35	11.77
Plinth	3.55	7.81	*Pony*	4.45	9.79	*Potash*	5⅜	11.825
Ploughman	3 6-10	7.92	*Popish*	4½	9.9	*Pratigue*	5 4-10	11.88
Plumbline	3⅝	7.975	*Poplin*	4.55	10.01	*Prayerless*	5.45	11.99
Plumiped	3.65	8.03	*Poppy*	4 6-10	10.12	*Precaution*	5½	12.1
Plural	3 7-10	8.14	*Population*	4⅝	10.175	*Preclusion*	5.55	12.21
Plush	3¾	8.25	*Populous*	4.65	10.23	*Predaceous*	5 6-10	12.32
Plutonian	3 8-10	8.36	*Porch*	4 7-10	10.34	*Predality*	5⅝	12.375
Pluvial	3.85	8.47	*Porker*	4¾	10.45	*Preference*	5.65	12.43
Pneumonia	3⅞	8.525	*Poringer*	4 8-10	10.56	*Prefigure*	5 7-10	12.54
Podag	3 9-10	8.58	*Porosity*	4.85	10.67	*Prehensible*	5¾	12.65
Podded	3.95	8.69	*Porter*	4⅞	10.725	*Prelatical*	5 8-10	12.76
Poise	4	8.8	*Porterage*	4 9-10	10.78	*Prelatist*	5.85	12.87
Polemic	4.05	8.91	*Porthole*	4.95	10.89	*Prelude*	5⅞	12.925
Police	4 1-10	9.02	*Portion*	5	11.	*Premature*	5 9-10	12.98
Politican	4⅛	9.075	*Poser*	5.05	11.11	*Premier*	5.95	13.09
Pollard	4.15	9.13	*Position*	5 1-10	11.22	*Premium*	6	13.2
Polyhedron	4 7-10	9.24	*Positively*	5⅛	11.275	*Preoccupy*	6.05	13.31
Polypus	4.25	9.35	*Possible*	5.15	11.33	*Prepaid*	6 1-10	13.42
Pomatum	4 3-10	9.46	*Postage*	5 2-10	11.44	*Prepossess*	6⅛	13.475
Pomology	4.35	9.57	*Posterity*	5.25	11.55	*Pressing*	6.15	13.53

Prices—U. S. A.—*Continued.*

Code Word.	Price per pound in cents.	Price per kilo in cents.
Pressure	6 2-10	13.64
Prevention	6¼	13.75
Preventive	6 3-10	13.86
Previous	6.35	13.97
Previously	6⅜	14.025
Prick	6 4-10	14.08
Prickling	6.45	14.19
Priestly	6½	14.30
Prim	6.55	14.41
Primarily	6 6-10	14.52

Code Word.	Price per pound in cents.	Price per kilo in cents.
Primordial	6⅝	14.575
Princely	6.65	14.63
Prism	6 7-10	14.74
Prisoner	6¾	14.85
Privateer	6 8-10	14.96
Privately	6.85	15.07
Privative	6⅞	15.125
Probably	6 9-10	15.18
Proceeds	6.95	15.29

Code Word.	Price per pound in cents.	Price per kilo in cents.
Procreate	7	15.40
Procurable	7⅛	15.675
Prodigious	7¼	15.95
Produce	7⅜	16.225
Profession	7½	16.5
Profitable	7⅝	16.775
Profitless	7¾	17.05
Prognostic	7⅞	17.325
Prone	8	17.6

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